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PETROUS PYRAMID OF TEMPORAL BONE

PNEUMATIZATION AND ROENTGENOLOGIC APPEARANCE

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CHICAGO

The routine histologic examination of temporal bones has served to determine important fundamental facts regarding the intracranial extensions of otitic suppuration.

The most important fact to be established has been that in the majority of cases fatal meningitis from acute suppuration of the middle ear has resulted from deep-seated foci of suppuration in the pyramid. These foci have in most cases not been reached by the exenteration of the mastoid cells, while in some cases, because of deep location and atypical symptoms, the otogenic origin of the meningitis has been completely overlooked until proved by the histologic examination.

Next in importance is the established fact that foci of suppuration in the petrous pyramid have occurred almost always in cases in which pneumatization of the pyramid was present. Exclusive of diffuse suppurative labyrinthitis and hematogenous metastatic foci in bone marrow, the occurrence of foci of suppuration has been found to depend on the presence of pneumatized areas. While such foci may become large, with extensive destruction of bony walls and invasion of adjacent marrow spaces and even of adjacent bones of the skull, the lesion begins as suppuration in pneumatic spaces from which drainage is inadequate or becomes partially or completely blocked off. The pathologic process is the same as in suppuration in mastoid cells, but since there is always more or less bone marrow in the petrous pyramid it is common to find some invasion of marrow spaces as a part of the destructive lesion.

Acute or chronic osteomyelitis of the petrous pyramid was found in my material only in cases in which pneumatized areas were present. The focus of suppuration had developed primarily in pneumatized areas in all instances.

Accurate knowledge of the location of pneumatized areas and the routes by which they develop is therefore of primary importance,

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because this information must be the basis for correct interpretation of clinical symptoms and signs, the proper technic for visualization of the various areas roentgenologically and the type of surgical procedures which must be adopted to remove or drain the focus of suppuration adequately.

Suppurative disease of the apex of the petrous pyramid has been recognized in isolated cases by the early otologists and has been discussed in the early literature by Troeltsch, Bircher, Urbantschitsch and Habermann.

Pneumatization of the temporal bone was studied by Siebenmann shortly after the turn of the century. In more recent years the recognition of the fact that suppuration of the pyramid is frequent and closely related to the presence of pneumatized areas has led to many anatomic studies. The methods used have included the corrosion technic, the study of gross specimens, roentgen examination and the study of serial sections of the temporal bone.

Of these methods, the latter is the only means at present of obtaining reliable and detailed information regarding the presence, location and connections of pneumatized areas and the routes by which they have developed.

The material on which the following studies on pneumatization have been made consists of serial sections of 100 temporal bones from patients from 4 years of age and upward. The histologic material used to demonstrate suppurative foci in the various pneumatized areas has been partly described in a previous publication [1] and has been accumulated since 1930. The roentgenograms used to demonstrate correlation of structure, pathologic condition and roentgen appearance are chosen mainly from cases in which the condition was acute and the findings were proved at operation. Partly because the observations on pneumatization have been found to be at considerable variance with those described in previous reports and partly because the results have an important and direct bearing on surgical procedures, it is necessary to give a somewhat detailed description of the pneumatized areas and the routes by which they develop.

The discussion of chronic suppuration in the petrous pyramid and the interpretation of roentgenograms in the presence of such conditions are not included in this report.

As there is still some variation in the terms used to describe the position both of the pyramid as a whole and of the various pneumatized areas within the pyramid, some clarification of terminology is needed.

1. Lindsay, J. R.: Suppuration in the Petrous Pyramid, Ann. Otol., Rhin. & Laryng. **47**:3, 1938.

The terminology chosen is that which is most practical from the standpoint of the otologist and corresponds closely to that suggested by Mayer.[2] The surface of the pyramid which borders on the middle fossa is called superior; that bordering on the posterior fossa is medial. The apex lies anterior and the base of the pyramid posterior.

When considered from the standpoint of the otologist the petrous pyramid falls naturally into two main parts, the perilabyrinthine region and the petrous apex. This division is convenient both because of the pattern of pneumatization and because of the different clinical and surgical problems created by suppuration in these two areas.

The perilabyrinthine areas lie anterior to the plane of the superior semicircular canal and the descending portion of the facial canal and extend anteriorly to the cochlear capsule and the internal auditory meatus. On roentgen examination the superior semicircular canal marks the posterior boundary of the perilabyrinthine area. Part of the labyrinth extends posterior to the plane of the superior canal and has been called the periantral area (Mayer), but from a practical point of view this area may be considered as part of the mastoid problem.

The perilabyrinthine areas which are commonly pneumatized may therefore be considered as superior, inferior and medial. The prefix "postero-" could be added to any of these areas to distinguish the location from similar regions of the apex.

The term "apex" is used to denote that part of the pyramid lying anterior to the cochlear capsule and the internal auditory meatus but medial to the carotid canal. The term "peritubal" is reserved for the cells surrounding the eustachian tube and lying lateral to the carotid canal.

This interpretation of the term "apex" is preferable from the clinical viewpoint, as suppuration in any part of this area will produce the same clinical and surgical problem and should therefore be classed under one heading, namely, "apicitis" or "suppuration of the apex." Also this interpretation of the term "petrous apex" is analogous to the common use and interpretation of the term "mastoid tip" and is equally correct.

Peritubal cells, which lie lateral to the carotid canal, because of their close relation to the tympanum or the eustachian tube, have more direct drainage and are rarely the cause of a complication. The distribution of these cells has been studied in as much detail as the material would permit, but a detailed description is not within the scope of this report.

The percentages given are those found in the 100 specimens examined. There might be considerable variation in percentages if a

2. Mayer, O.: Die Pyramidenzelleneiterungen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **42**:1, 1937.

larger series were examined, but the conclusions which may be drawn from this series would remain the same, as the surgical measures to be adopted must be adequate for all anatomic variations.

The roentgenograms which are presented have, with the exception of fig. *7 a* and *b,* been prepared in the University of Chicago Clinics' department of roentgenology under the direction of Prof. Paul C. Hodges.[3]

THE PERILABYRINTHINE AREAS

1. *The Superior (or Posterosuperior) Area.*—Pneumatization was present in 36 per cent of the specimens. The origin of cell tracts pneumatizing the superior area was as follows:

From the epitympanum only, no connection with the mastoid cells (figs. 1, 2 *a* and 3 *b*)	18%
From the epitympanum, plus a tract from the mastoid, in the "angle" or over the superior semicircular canal (fig. 2 *b*)	9%
From the epitympanum, plus a tract through the subarcuate region	4%
From the mastoid only, through the angle	2%
From the mastoid only, through the subarcuate region (fig. 3 *a*)	3%
Total	36%

It is apparent from these figures that the superior area is frequently pneumatized and that the primary route is from the epitympanum directly.

In less than half the pneumatized specimens there was pneumatization both from the epitympanum and from the mastoid, while in a few cases there existed only a tract from the mastoid, either along the angle or through the subarcuate fossa.

In specimens in which pneumatization occurred both from the epitympanum and by a tract from the mastoid, the two tracts remained entirely separate, although divided by a thin bony wall. Exceptions to this occurred in at least 2 cases of suppuration of which histologic examination was made in 1 and the observations verified by operation in 1, but the communication in both cases may have been due to the suppuration.

For this report only specimens in which the pneumatization had reached as far as the superomedial angle have been recorded as pneumatized. The clinical and surgical importance of these observations is at once apparent. A focus of suppuration may exist in the superior

3. For details as to the roentgen technic used the reader is referred to an article by P. C. Hodges (An Apparatus for Stereoscopic Roentgenography of the Skull, Am. J. Roentgenol. **42**:921 [Dec.] 1939).

cells and be completely walled off from the mastoid by the dense bone of the labyrinthine capsule. Such was the condition revealed by histologic examination in 3 fatal cases in my experience, while in a fourth the only communication to the superior area was through the subarcuate region (figs. 1, 2 and 3).

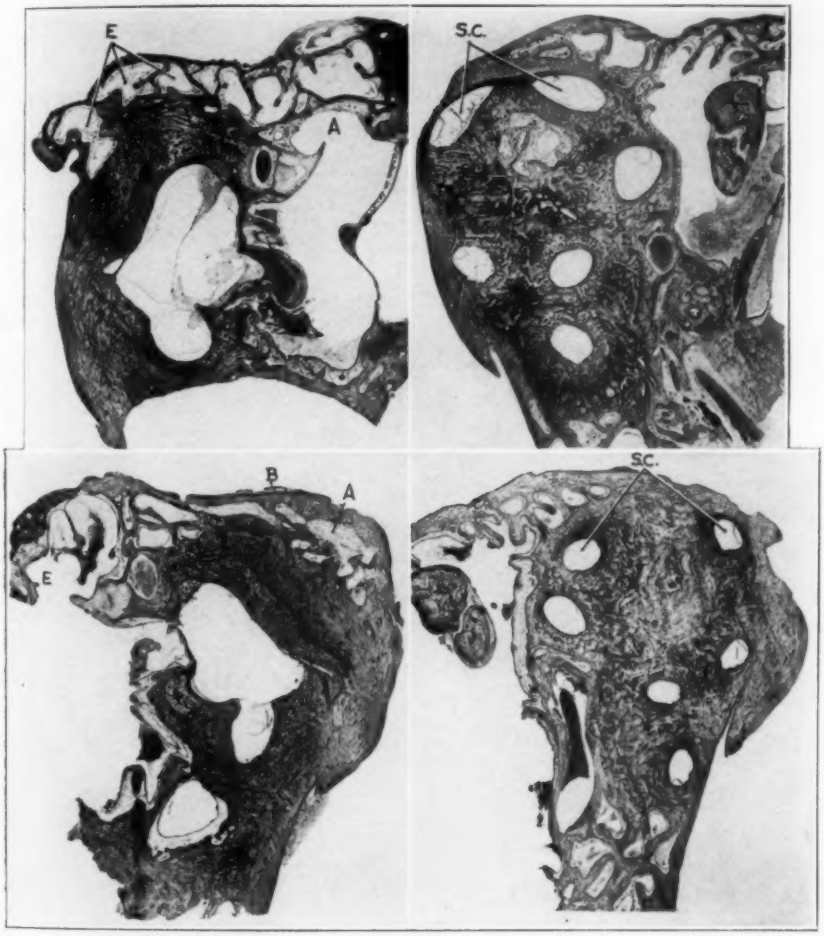

Fig. 1.—Above, on the left, the superior area (*E*) is seen to be well pneumatized. These cells developed from the epitympanum only (*A*). The section on the right shows how the superior canal (*S. C.*) separates the superior cells from the mastoid. There is beginning pneumatization through the subarcuate fossa from the mastoid, which does not reach the superior cells. The patient died of meningitis, by extension of suppuration in the superior cells of the opposite ear. Below, suppuration in the superior area, *A* (left), extended to the middle fossa. This area was pneumatized from the epitympanum (*E*) only. The superior canal, *S. C.* (right), formed a complete barrier between the diseased area and the mastoid cells. New formation of bone is seen at *B*.

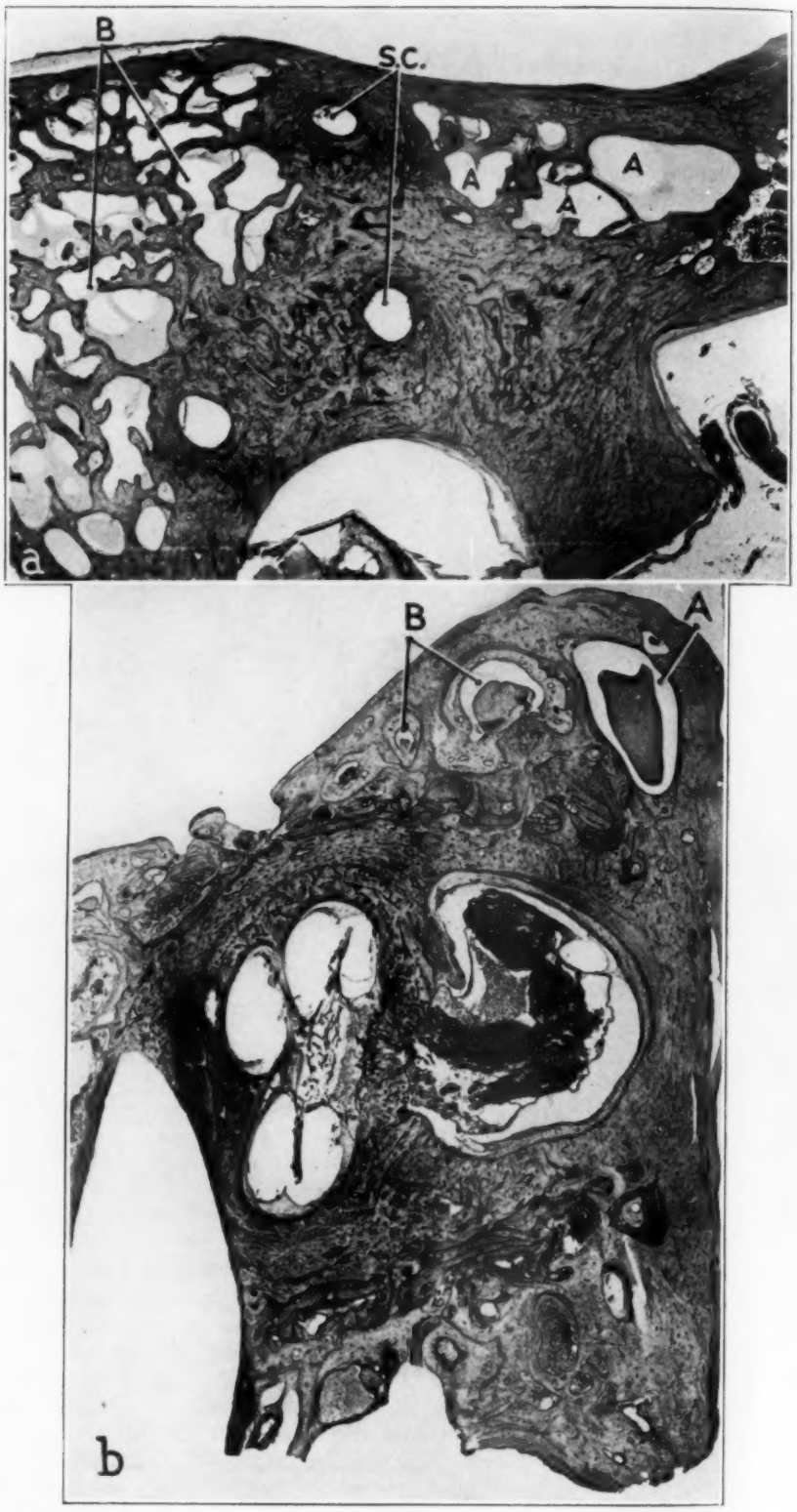

Fig. 2.—Vertical longitudinal section (*a*) of a pyramid, showing a pneumatized superior area, *A*, separated entirely from the mastoid, *B*, by the semicircular canals, *S. C.* The cells, *A*, developed from the epitympanum. The superior cell area in *b* has been pneumatized from two sources. Cell *A* has developed from the mastoid; cells *B*, from the epitympanum. These tracts have remained separate.

Roentgenologic Appearance: The roentgen examination usually gives reliable information regarding the superior area. The projection which allows best visualization is Stenvers' view or some of the modifi-

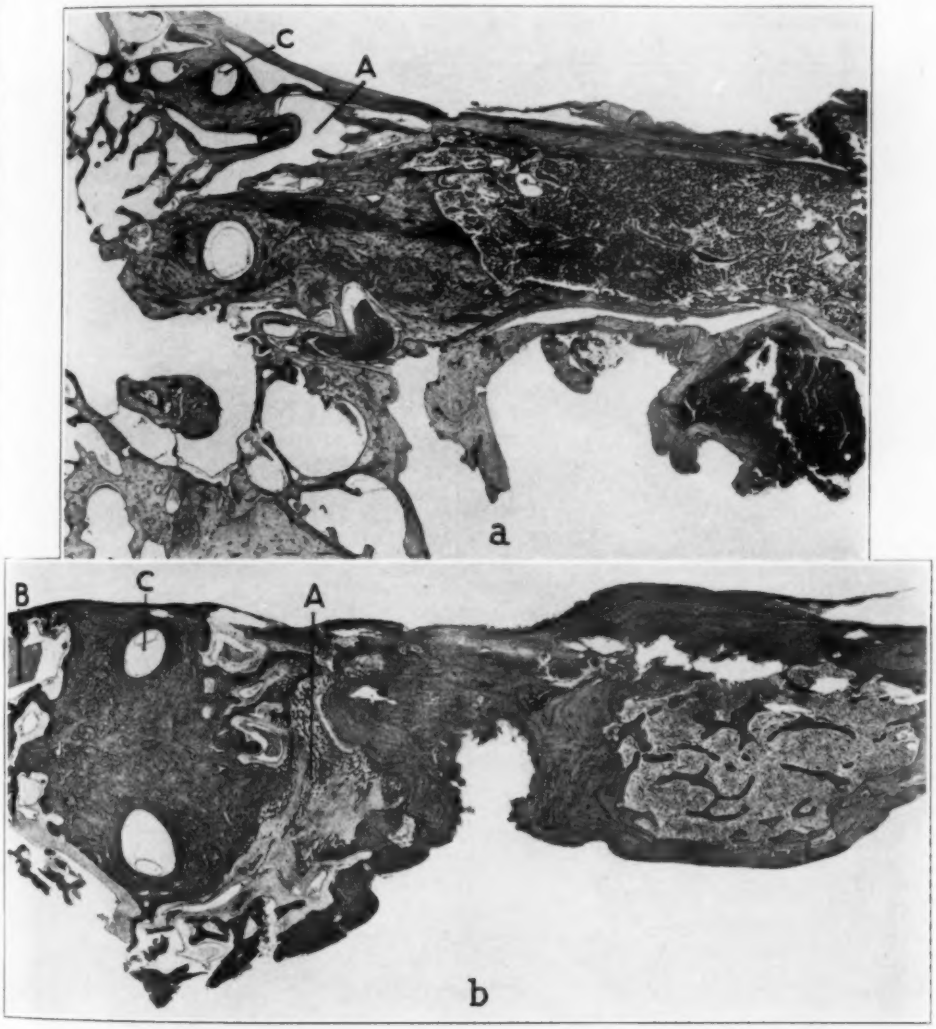

Fig. 3.—In *a* pneumatization of the superior angle, *A*, through the subarcuate region only is seen. The cells in the angle border both on the superior and the medial surfaces of the pyramid. The superior canal is seen at *C*. In *b* suppuration has invaded the superior area, *A*, from the epitympanum, with extension to the meninges. The superior canal, *C*, separates the area from the mastoid cells, *B*.

tions of it. This view shows the superior canal clearly and may indicate whether a cell tract exists between the canal and the cortex. It shows pneumatization in the superior area, if present, and is also the best

view to show an extension of the superior perilabyrinthine cells into the superior part of the apex (figs. 4 and 5 *a* and *b*).

It is important to realize, however, that this view does not show pneumatization in the posteromedial perilabyrinthine area, unless that pneumatization reaches up to the region of the superior angle (to be

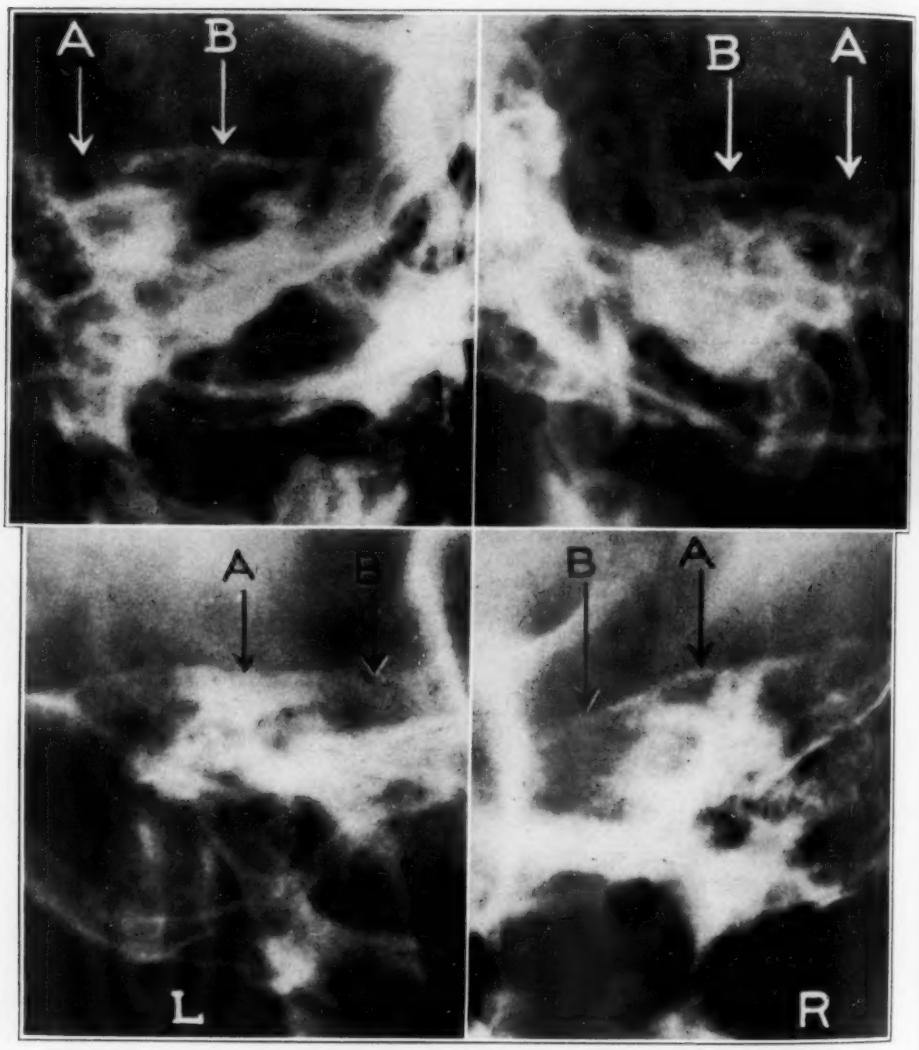

Fig. 4.—Above, Stenvers' projection, showing pneumatization of the superior area, *A*, on both sides, extending into the apex. There is definite asymmetry, a common finding in pneumatized pyramids. Below, pneumatized superior area, *A*, on the right, with decreased density of the apex, *B*. (On the axial view cell outlines can be seen.) The corresponding areas on the left are dense. Prolonged suppuration in the left ear persisted after complete mastoidectomy.

illustrated later). Also, in my experience, when the apex is pneumatized only in the lower levels, which is a frequent observation, Stenvers' projection does not show up these areas as reliably as the axial (mento-vertical) view.

Another method which gives information regarding the superior area is the transorbital frontodorsal projection. This view has the advantage of being easier to obtain, for instance in very young children,

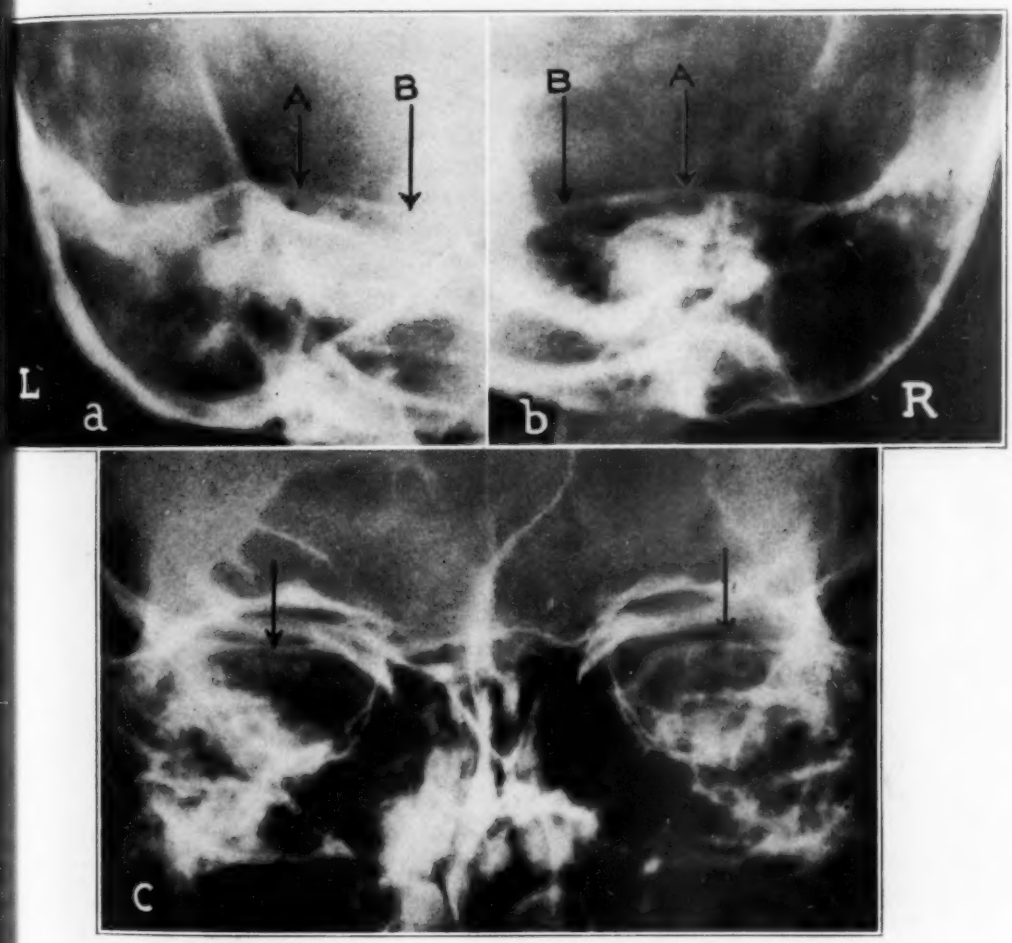

Fig. 5.—Stenvers' projection (*a* and *b*), showing asymmetry of the petrous pyramids. The superior area, *A*, is pneumatized on both sides, but dense on the left. The apex, *B*, is pneumatized on the right, and cells extend to the superior border, suggesting that the apex has been pneumatized, at least in part, from the superior cells. The apex on the left appears dense. The patient had tuberculous otitis. Transorbital view (*c*), showing pneumatization of superior areas and apexes and asymmetric pneumatization of the pyramids.

and shows both sides with the one exposure, but has the disadvantage of being an oblique projection, while at the same time failing to show the apexes completely and also the periantral and the mastoid region (fig. 5 *c*).

2. *The Posteromedial (or Medial) Area.*—Pneumatization was present in 25 per cent of the specimens.

This group includes only specimens in which a cell tract extended from the mastoid anteriorly between the aquaeductus endolymphaticus and the posterior fossa. Specimens in which only the cells in the superior angles reached the cortex of the posterior fossa are grouped with those having pneumatization in the superior cell area, because the diagnostic and surgical problem is the same.

Pneumatization of the posteromedial tract was seen in bones in which a large amount of periosteal bone has been laid down on the posteromedial (medial) surface of the labyrinth, making it possible for pneumatization to develop forward from the mastoid between the aquaeductus endolymphaticus and the cortex, thus bordering on the posterior fossa (figs. 6, 7 and 8).

Since this area is pneumatized from the mastoid, suppuration must reach it by way of mastoid cells, but it is not uncommon to find that the tract by which the infection entered the area is obliterated sufficiently to escape gross inspection at operation. In such cases roentgenologic information is indispensable as an indication that a focus of suppuration lies deeper (fig. 7 *c*).

Roentgenologic Appearance: Stenvers' view will show pneumatization in the posteromedial area only if the cells extend into the superior angle.

The most useful view to show this area in all cases is the fronto-dorsal projection, which was first presented by Grashey and which is referred to throughout this report as the "occiput-down view." Many variations of this view have since been described. Pneumatized tracts which extend along the medial border of the pyramid but which may not reach the superior angle are shown clearly by this view (fig. 7 *c*).

The axial projection first described by Schuller, in 1905, also shows the posteromedial cell tract, but less clearly than the previous view (figs. 8 *c* and 7 *c*).

Surgical Application: An illustration of the value of accurate roentgenologic information is shown in figure 7 *c*, which was made in a case in which otitic meningitis due to infection with Pneumococcus type III extended from a coalescent abscess in the posteromedial cells on the right side into the posterior fossa. The abscess was cleaned out surgically, but it was only after curetting anteromedially beyond the level of the posterior semicircular canal through about 1 cm. of bone partly sclerotic that the abscess was entered.

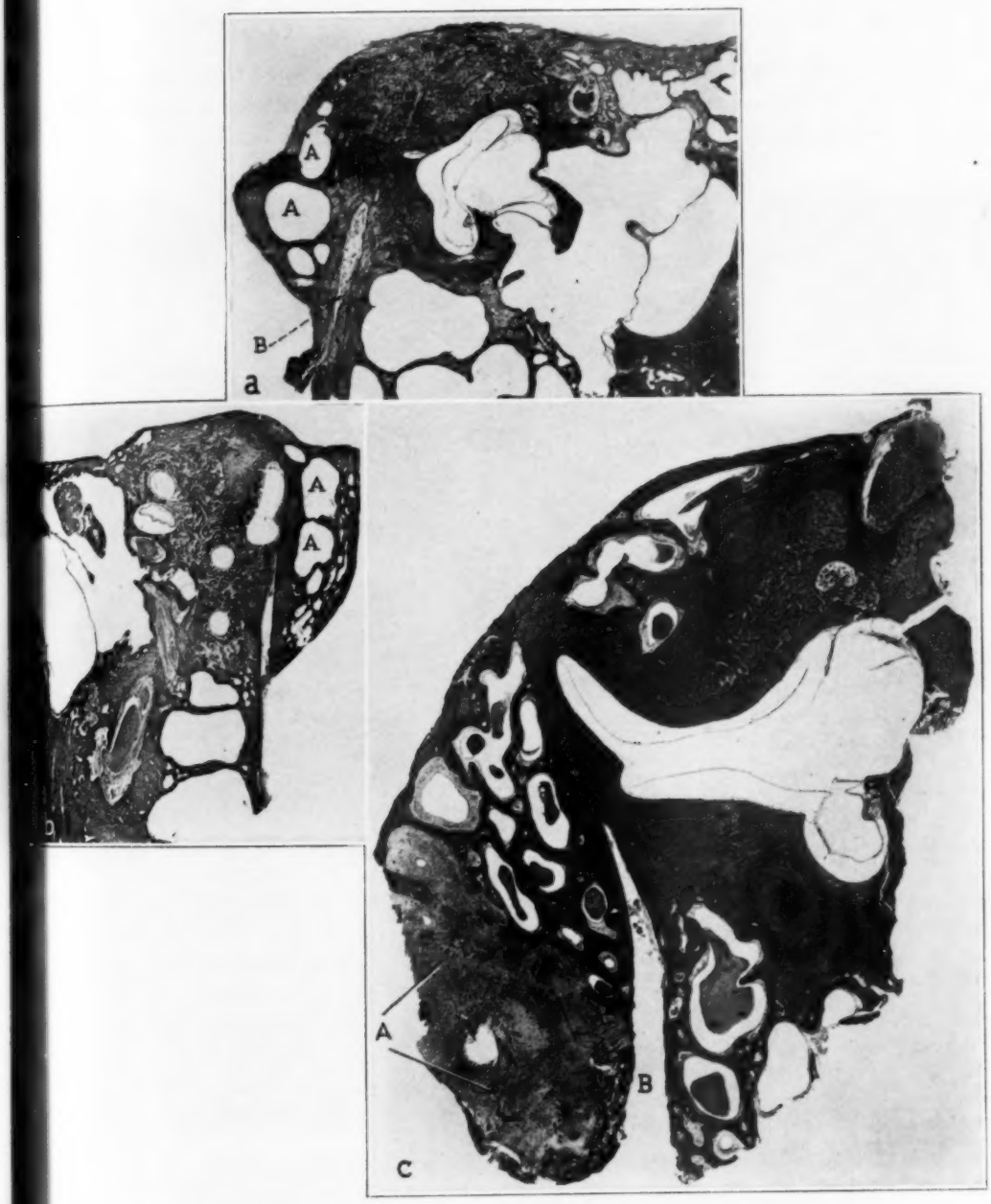

Fig. 6.—Vertical section (*a*) through the middle ear, showing a pneumatized posteromedial area, *A*, which lies between the aquaeductus endolymphaticus, *B*, and the posterior cranial fossa. These cells lie well below the superior angle of the pyramid. The posteromedial cells, *A*, are well developed in *b*. The area does not reach as high as the labyrinth and would, therefore, not be evident on Stenvers' roentgen projection. Meningitis resulted in *c* from extension of an abscess, *A*, in the posteromedial area into the posterior cranial fossa. The aquaeductus endolymphaticus is seen at *B*.

Stenvers' views (figs. 8 *a* and *b*) gave no suspicion of the location of the abscess in this case, but the other views indicated clearly the area to be explored surgically (figs. 7 *c* and 8 *a* and *b*).

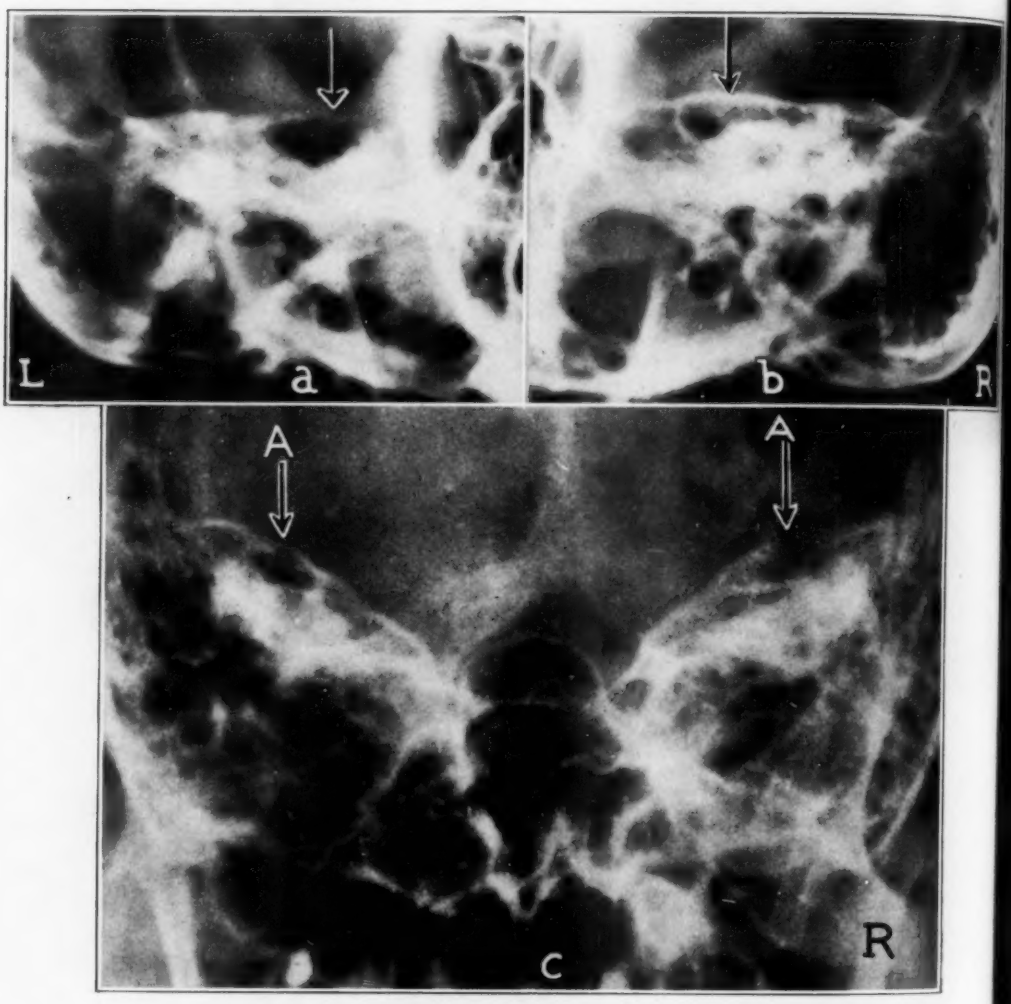

Fig. 7.—In *a* and *b* the superior cell area is pneumatized on the right, the cells extending into the superior angle of the apex. The superior perilabyrinthine area on the left is clouded, but in the superior part of the apex is a large area of decreased density with an erosion through the ridge. The presence of this necrotic area was verified at operation. Not seen on Stenvers' view, however, was a well developed posteromedial group of cells which was a part of the necrotic focus and allowed surgical drainage of the area from the mastoid. The occiput-down view (*c*) is from another case, illustrating a well pneumatized posteromedial cell area, *A*, on both sides, with increased density on the right. The mastoid cells also are well shown and are clouded on the right. An abscess was found at *A* on the right, eroding into the posterior fossa.

The posteromedial cell tract does extend up into the superior angle in a certain group of cases, and in such instances the upper part of the area shows on Stenvers' views. A good example is shown in figure

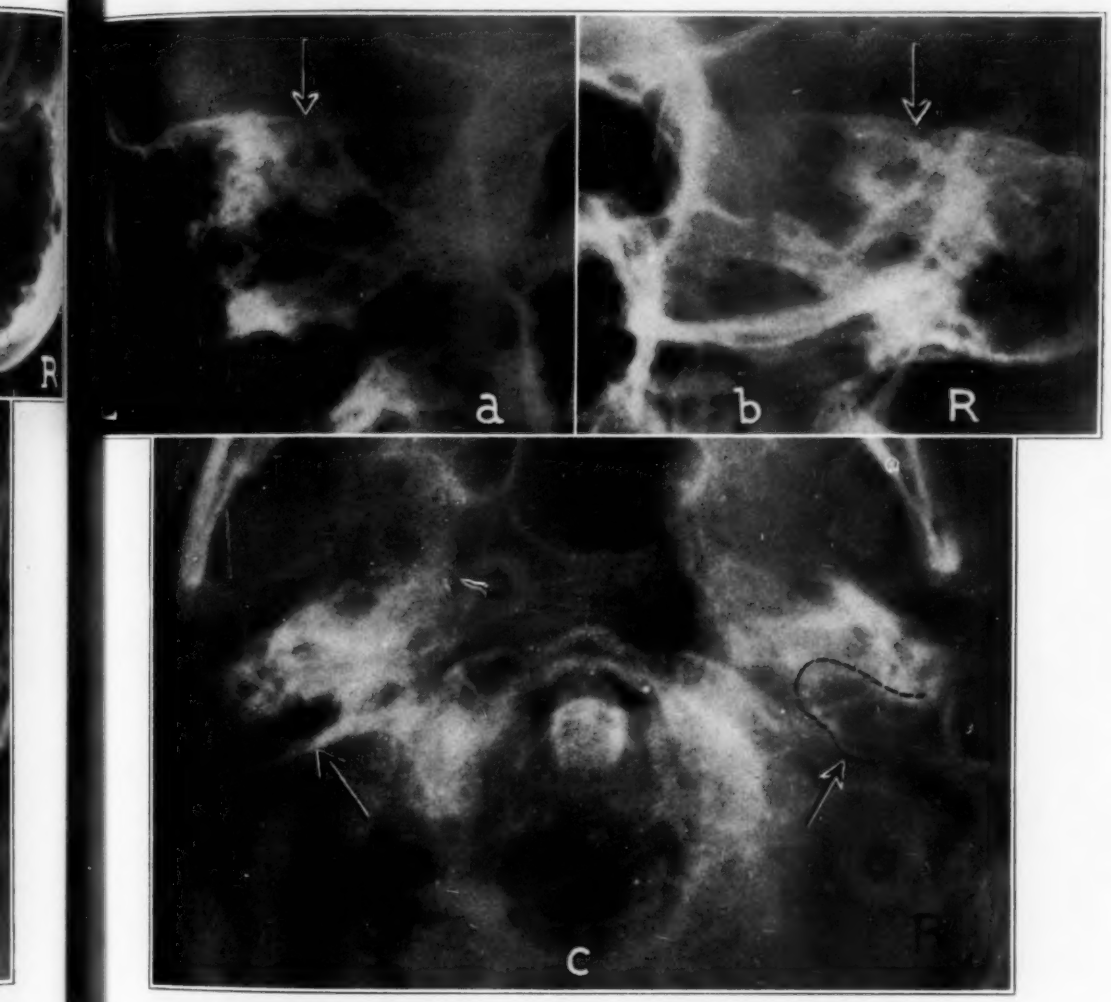

Fig. 8.—Stenvers' view (*a* and *b*) of the subject shown in figure 7 *c*. This view gives no indication of the large pneumatized posteromedial areas seen on the occiput-down view. The superior areas appear fairly symmetric. The presence of a posteromedial cell tract may be shown on the axial view (*c*) also, but the contrast is less distinct than on the occiput-down view (fig. 7 *c*). The posteromedial area lies within the dotted line on the right.

7 *a* and *b*. In Stenvers' view an area of decreased density is seen in the superior angle of the pyramid, with erosion of the cortex. Stenvers' view, however, gives only a partial picture in this case. The occiput-

down view indicated the presence of a tract of posteromedial cells not shown in figure *7 a* and *b*, and at operation it was possible to follow this partly sclerosed tract medial to the posterior canal and forward into the necrotic area above the internal meatus. The posteromedial and superior areas, as well as the superior angle of the apex, were occupied by one necrotic mass, and the superior bony angle was eroded away.

It is evident from these illustrations, then, that Stenvers' and the occiput-down view both are necessary when a lesion in the petrous pyramid is suspected. The importance of the posteromedial perilabyrinthine cells as a common location for suppuration is shown by figures *6 c* and *7*, and the information which is to be obtained from the occiput-down view is of particular value as a guide to the surgical approach. It is always possible to reach the region from the mastoid, but, since the tract leading forward to the area may be composed of small cells or even be sclerosed, a suppurative focus might be overlooked if accurate roentgen evidence were not at hand.

INFRALABYRINTHINE CELLS

The infralabyrinthine area was pneumatized to some extent in 25 per cent of the specimens, which may be subdivided into groups according to the extent and origin of pneumatization:

(*a*) Those with a tract from the hypotympanum to the mastoid (fig. 9 *a*) 13%

(*b*) Those with a tract from the mastoid forward to either the jugular bulb or the round window niche but not connecting with the hypotympanum (fig. 9 *b*) 8%

(*c*) Those with a tract from the hypotympanum limited to the infralabyrinthine area (fig. 9 *c*) 3%

(*d*) Those with infracochlear cells leading into the apex (fig. 12 *b*) 6%

(*e*) Those with a combined tract underlying the labyrinth from the mastoid to the apex; this group is included also in group *d* (fig. 10) 4%

It is evident from these figures that infralabyrinthine cells vary greatly in origin and extent.

In the majority, the pneumatized area extends from the mastoid to the jugular bulb or round window niche (groups *a* and *b*). It is evident from the figures that the area is pneumatized from the mastoid in at least a large percentage of cases, which probably creates a greater tendency for suppuration to be walled off in it than if there is an opening to the hypotympanum.

While it is understandable that simple infralabyrinthine cells (group *c*) may cause persistent drainage in chronic conditions, these

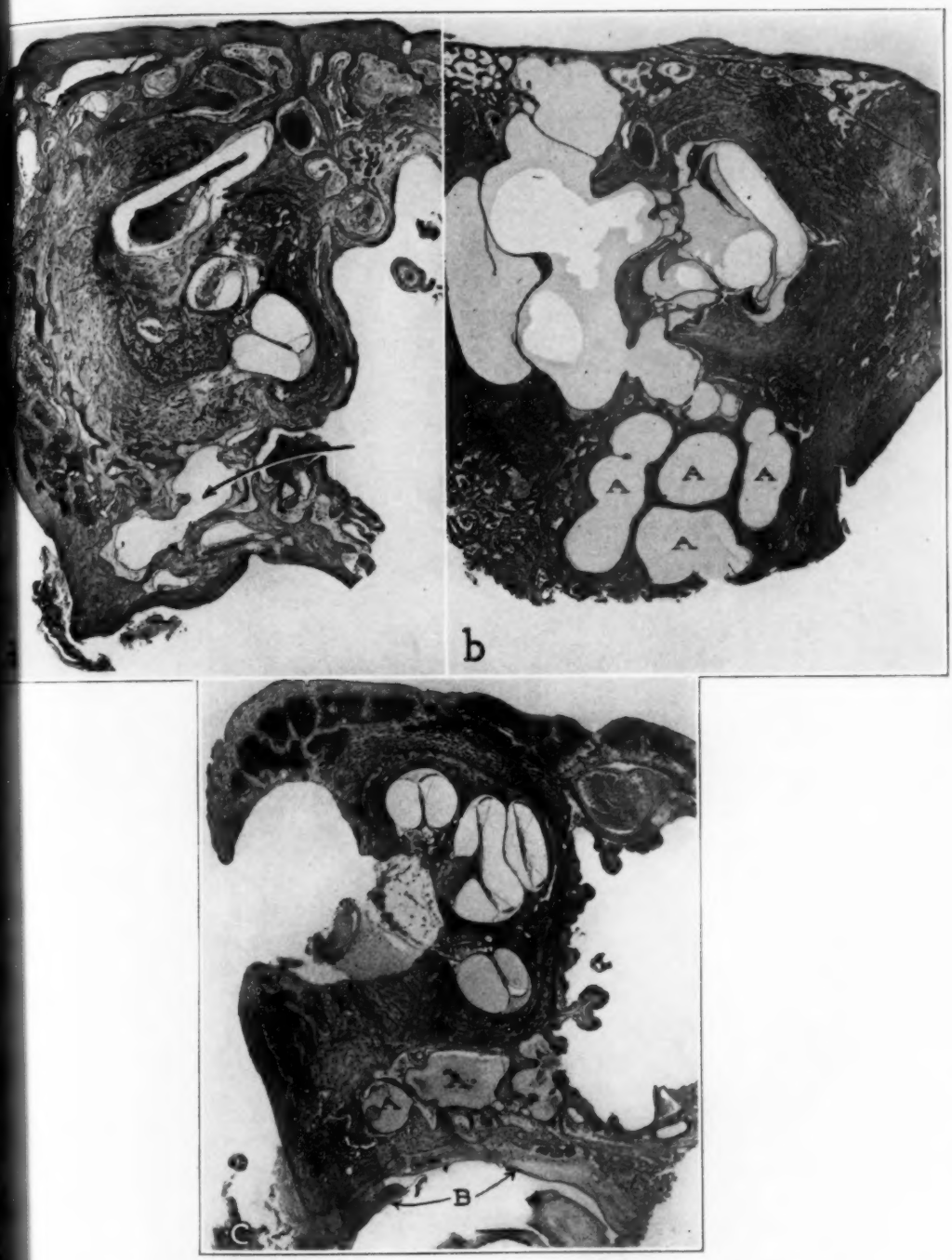

Fig. 9.—Vertical section (*a*) to show origin of a tract of infralabyrinthine cells extending from the hypotympanum posteriorly to the mastoid. The infralabyrinthine cell tract, *A*, in *b* developed from the mastoid and does not connect with the hypotympanum. Infralabyrinthine cells, *A*, were already present at 7 months in *c*. The patient had pneumococcic otitis media with thrombosis of the jugular bulb. The inflammatory changes in the walls of the jugular bulb, *B*, should be noted.

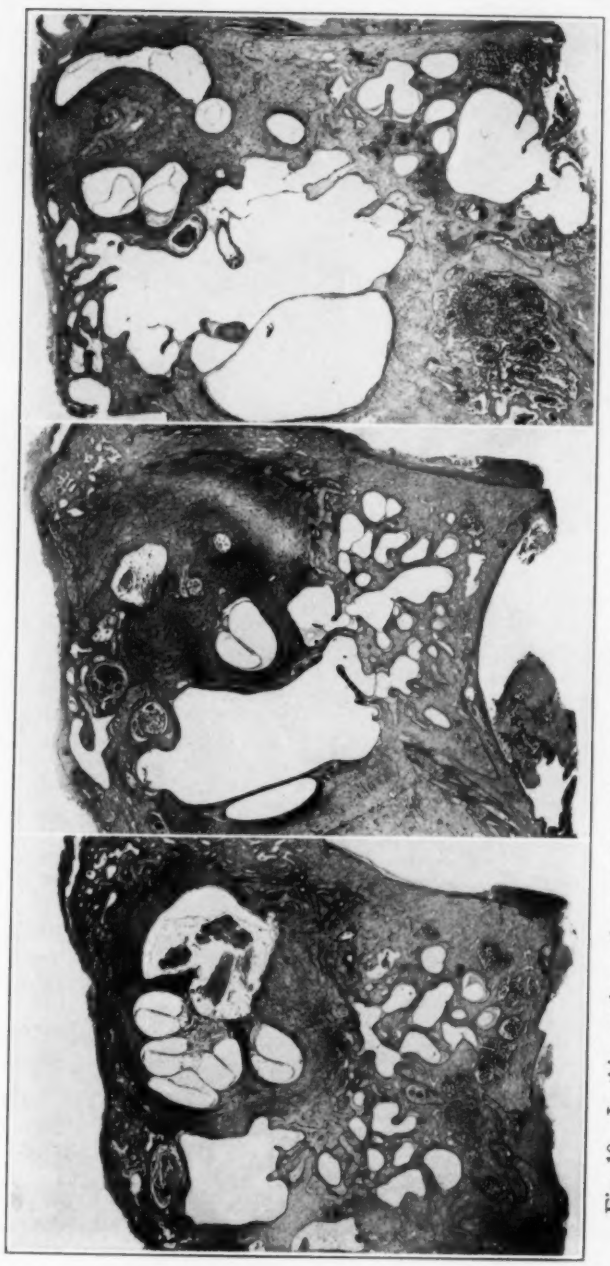

Fig. 10.—In this specimen the superior and posteromedial areas are not pneumatized, but the labyrinth overlies a layer of pneumatic cells throughout its length.

cells probably are seldom the cause of a complication in acute suppuration. However, figure 9*c* shows a section from a 7 month old infant with pneumococcic otitis, thrombosis of the jugular bulb and meningitis, and it appears that the early infralabyrinthine pneumatization may have been an important factor in the development of thrombosis of the bulb. Cases have also been reported in which suppuration has invaded the aquaeductus cochlearis from infralabyrinthine cells.

Group *d* will be discussed in the section entitled "The Petrous Apex."

Group *e* comprises bones in which the labyrinth was placed at a high level against the middle fossa but rested on a bed of pneumatic cells extending from the mastoid to the apex. This type is relatively infrequent (4 per cent), a fact which limits to a low percentage of cases the possibility of reaching the apex surgically from the mastoid by the infralabyrinthine route.

The cells in these specimens were not a single tract which develops from the mastoid to the apex. As has been shown, the cells develop partly from the hypotympanum and partly from the mastoid, and therefore a direct tract from the mastoid to the apex is rare, but in the presence of suppuration and necrosis surgical entry to the apex would probably be facilitated.

Roentgenologic Appearance.—None of the present views are particularly satisfactory to show the infralabyrinthine cells. Because of the relation to the base of the skull a satisfactory projection has not been developed. In Stenvers' view, which is perhaps the most useful, the labyrinth partly overlies the infralabyrinthine area.

THE PETROUS APEX

For reasons stated previously the term "petrous apex" is used to apply to the part of the pyramid anterior to the cochlea and internal meatus and medial to the carotid canal.

The petrous apex was pneumatized in 21 per cent of the specimens, which may be classified as follows:

(*a*) Those pneumatized only in the superior part as an extension from the superior angle (fig. 11)	7%
(*b*) Those pneumatized from the anterior part of the tympanum and the eustachian tube (figs. 12 and 13)	14%
Total	21%

Group *a* includes all specimens pneumatized from the superior cells or the angle. In part of these, therefore, the apex was in direct connection with the mastoid, but in some its cells were extensions from the epitympanum only. Some of these specimens also had some pneumatization from the anterior part of the tympanum, but there was never any communication between the two cell tracts.

Group *b* represents the type of pneumatization studied and demonstrated with reconstructions by Anson, Wilson and Gaardsmoe.[4] This group showed a great variation in the extent and in the location of the tract leading into the apex. The majority contained only a few cells, which, however, were usually large. In some specimens a single large cell was present. In 1 specimen (fig. 12 *a*) the superior part of the

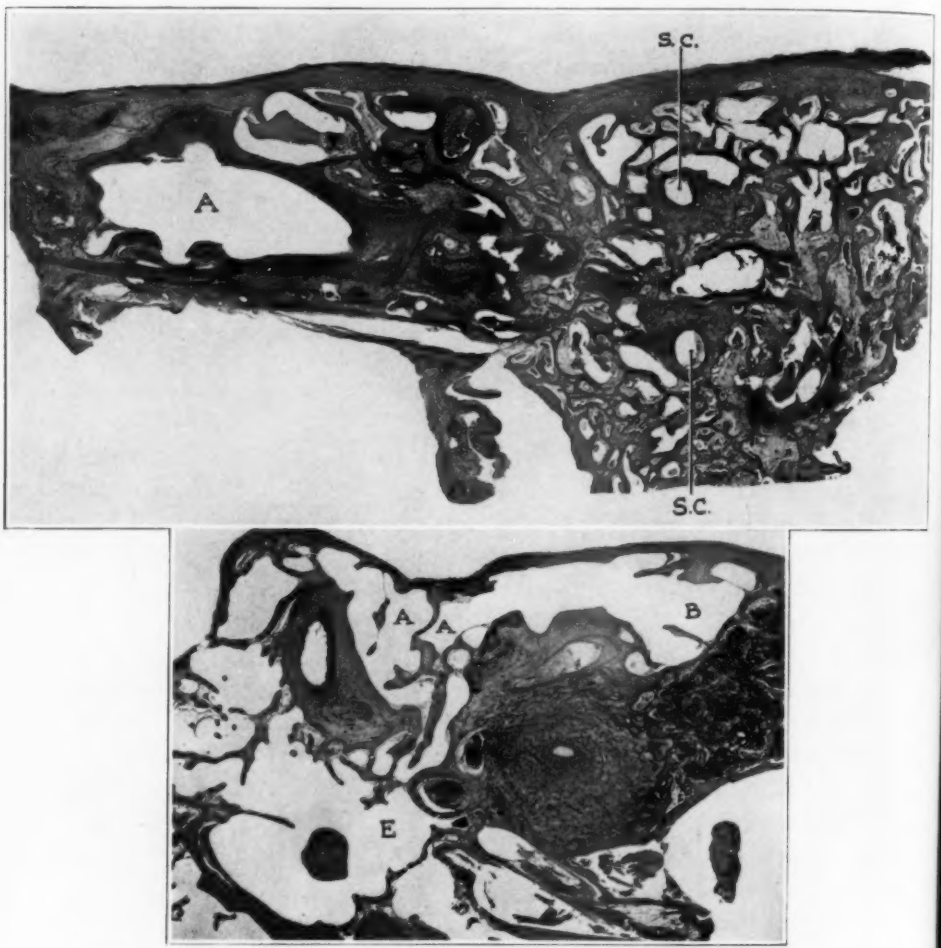

Fig. 11.—Above, suppuration reached the apex, *A*, in this specimen by way of the superior cells, which connected with the mastoid cells around the superior canal, *S. C.*, and through the subarcuate fossa. Below, pneumatization from the superior area, *A*, into the superior part of the apex, *B*. This tract developed mainly from the epitympanum, *E*.

4. Anson, B. J.; Wilson, J. G., and Gaardsmoe, J. P.: Air Cells of Petrous Portion of the Temporal Bone in a Child Four and One-Half Years Old: Study Based on Wax Plate Reconstructions, Arch. Otolaryng. **27**:588 (May) 1938.

apex was mostly dense bone while the lower part was extensively pneumatized. In several the pneumatization did not approach the superior surface. The tracts by which the apical cells developed included several types, namely:

1. Through the angle between the knee of the carotid canal and the cochlea.

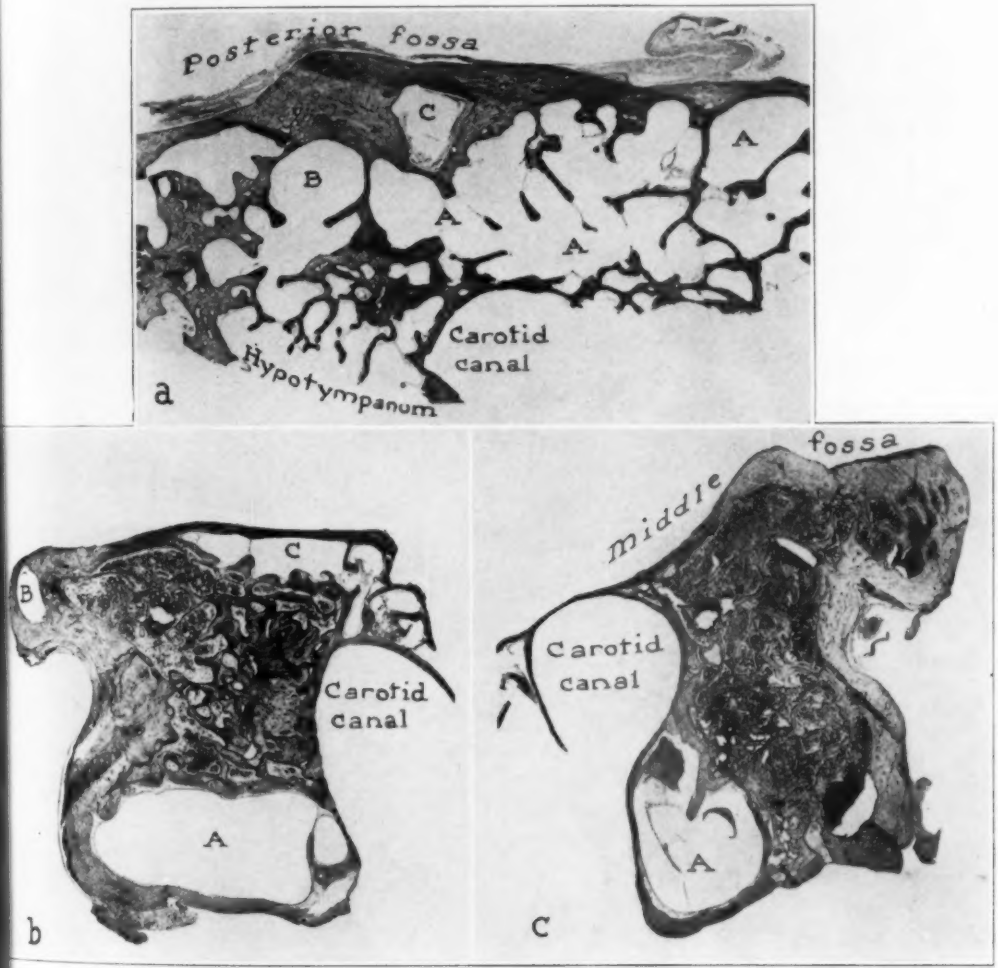

Fig. 12.—A horizontal section (*a*) beneath the labyrinth. The lower part of the apex, *A*, is extensively pneumatized from the hypotympanum, but the upper levels are dense bone, with only a few narrow spaces. The infralabyrinthine cells, *B*, are a separate extension from the hypotympanum. *C* indicates the cochlear aqueduct. Vertical section (*b*) through an apex showing three routes by which pneumatization may develop. Cell *A* came from the hypotympanum, cell *B* from the mastoid through the superior angle and cell *C* from the tympanic cavity over the knee of the carotid canal. The single large cell, *A*, in the apex shown in *c* developed from the eustachian tube, anterior to the ascending carotid canal.

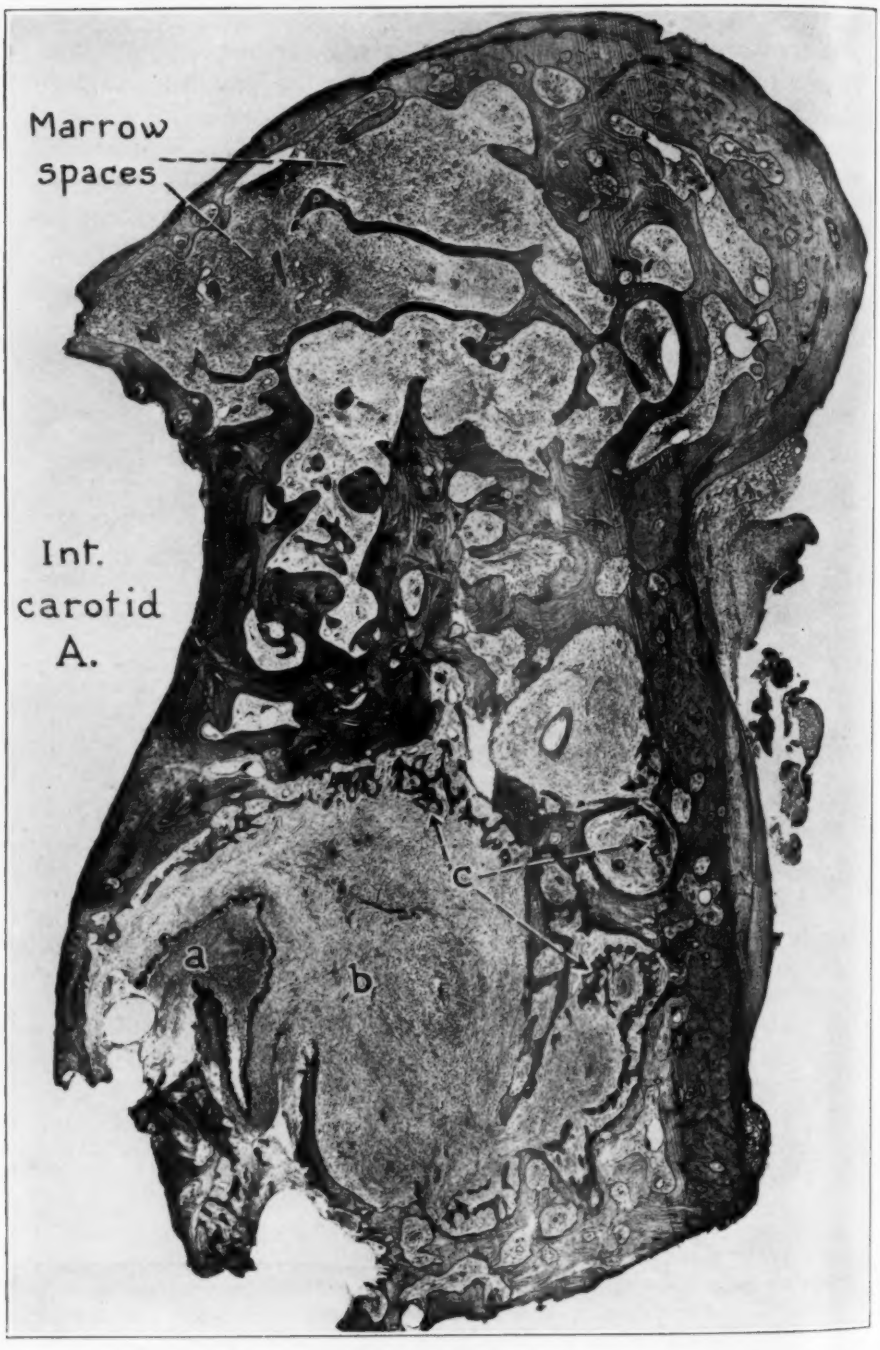

Fig. 13.—Vertical section through the apex. The focus of suppuration developed in the pneumatic space, *a*, which extended from the hypotympanum. Much tissue is seen at *b*, with osteogenesis at *c*. This area could not have been reached by way of the middle fossa or from the mastoid.

2. Beneath the cochlea and medial to the ascending carotid canal.
3. In front of the ascending carotid canal.
4. Above the horizontal part of the carotid canal.

In at least 1 specimen the tract originated from the eustachian tube rather than directly from the tympanum.

It must be realized that figures on pneumatization in all areas of the pyramid vary according to the material examined. However, to cite actual figures is of less importance than it is to establish the existence of certain general types of pneumatization with approximate percentages, so as to provide a guide for clinical interpretation and roentgen study and to form a basis for adequate surgical intervention.

Roentgenologic Appearance.—The petrous apex may be shown by two projections, Stenvers' view and the axial. The former requires separate exposure for each pyramid, while the latter has the possible advantage of showing both pyramids on one exposure. These two views are taken in entirely different planes, the former being approximately perpendicular to the medial surface of the pyramid and the latter perpendicular to the inferior surface. Therefore both views are necessary if the maximum information is to be obtained about the apex.

Stenvers' view is useful in indicating whether the apex is pneumatized in the superior part and usually indicates if the pneumatization is an extension from the superior cells. It is also the most useful view to show erosion of the superior angle of the apex.

The axial view, however, is best to show pneumatization of the apex from the anterior part of the tympanic cavity or tube, which usually occurs in the lower part of the apex. By this view it is often possible to determine the location of cells even when pneumatization is limited (figs. 13 and 14 *a*). The axial view, however, will not show the superior or infralabyrinthine cells.

When there is extensive pneumatization it can be easily shown by either the axial or Stenvers' projections. It is important to realize, however, that pneumatization of the apex is frequently limited to the lower half (figs. 12 and 13) and that in such cases Stenvers' view alone cannot be depended on. Both views should always be taken when the petrous apex is in question.

Surgical Application.—Because pneumatization of the apex develops from the perilabyrinthine areas only in the minority of cases, surgical access to the apex by way of the perilabyrinthine cell tracts from the mastoid is limited to a correspondingly small group of cases.

Access to the apex by way of the middle fossa is feasible only when there has been erosion through the superior surface of the bone

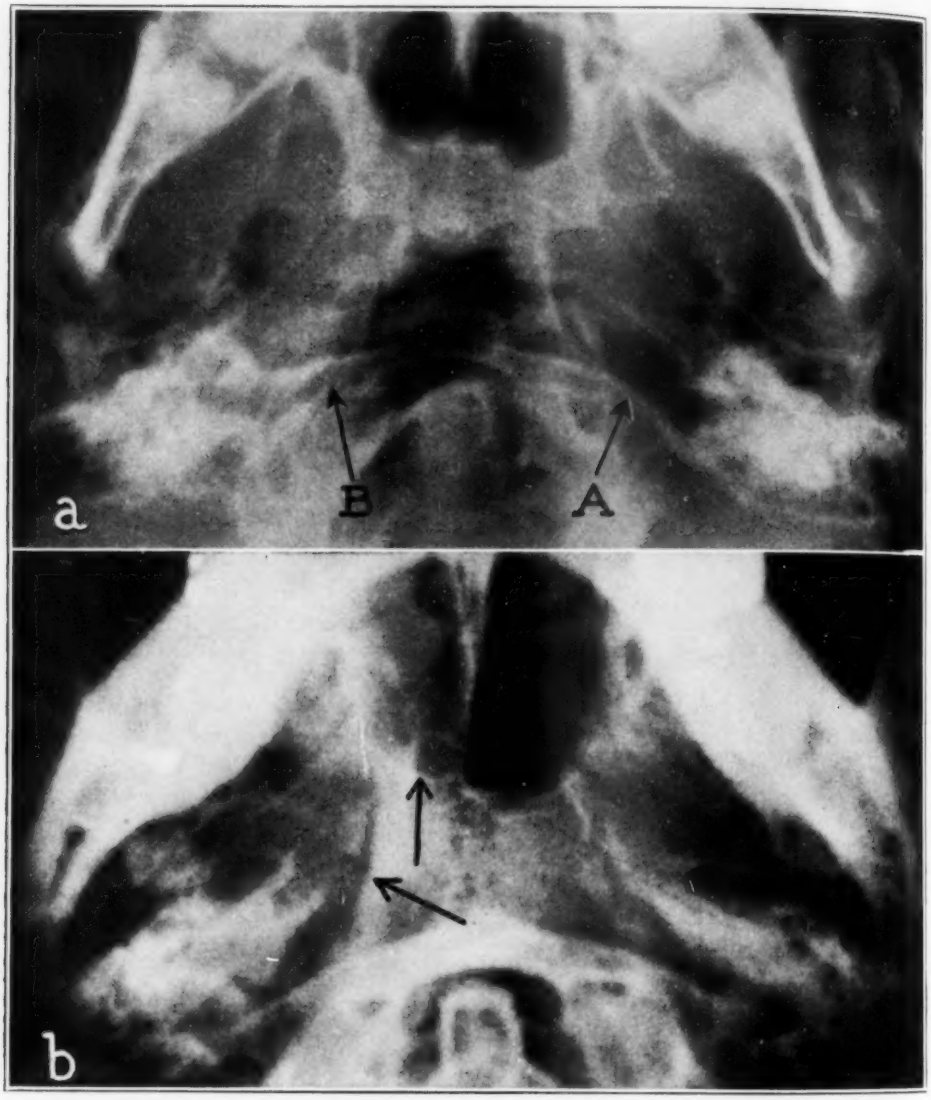

Fig. 14.—In *a* is shown acute suppuration on the right side, with signs of complication in the posterior fossa. Complete mastoidectomy was performed without improvement, after which septic temperature and bacteremia developed. Queckenstedt's sign was normal. The axial view shows that the normal apex, *A*, is partly pneumatized while the corresponding area, *B*, on the diseased side is dense. Stenvers' views failed to bring out this contrast. The operation on the apex by the approach through the eustachian tube was followed by uneventful recovery. In *b* is seen an example of suppuration in the apex with extension to the sphenoid sinus. The mucosa of the sinus was greatly thickened. Attempts to drain this apex by way of the mastoid and by way of the middle fossa were unsuccessful. The patient was treated in 1934.

or when the superior cortex is thin and the focus of suppuration directly beneath it. Histopathologic studies show that such conditions may be expected only in a minority of cases. The majority of apical cells develop from the anterior part of the tympanum or the tube, usually from the hypotympanum, and in many such cases the pneumatized area is separated from the cortex of the middle fossa by as much as a centimeter of bone, which may be relatively dense. In these cases the only feasible and rational surgical approach is by way of the middle ear and the mouth of the eustachian tube.

These figures on pneumatization correspond with my practical experiences. The apex can usually be drained adequately by the posterior approach in cases in which pneumatization has extended from the superior and posteromedial perilabyrinthine areas. These cases belong in the general group of cases of "posterior petrositis." However, suppuration in apexes which have been pneumatized from the anterior part of the tympanum (anterior petrositis) requires the anterior approach, via the mouth of the eustachian tube, for adequate drainage.

PERITUBAL CELLS

All cells lying above, below and lateral to the tube, as well as those between the carotid canal and the tube and those which extend medial to the carotid canal, are considered peritubal. These cells open mainly from the middle ear but in some instances open directly off the tube. In the latter instances they frequently are lined by ciliated epithelium, although this is not constant. Ciliated epithelium, however, was not observed to extend into the cells within the apex, although in some instances these may be extensions of peritubal cells.

A detailed study of peritubal cells is not included in this report, but the presence of peritubal cells was noted in a much higher percentage of specimens than was that of cells in any of the perilabyrinthine areas.

Because of their direct proximity to the tube, simple peritubal cells which do not extend into the apex tend to drain freely and are therefore seldom the cause for complications in acute suppuration.

INTERPRETATION OF ROENTGENOGRAMS

Histologic studies show that there is more or less variation in the degree of pneumatization in the two sides in the majority of pneumatized pyramids. As a general rule, however, this variation is only one of degree.

Pneumatization of any area in the pyramid on one side is usually accompanied by some degree of pneumatization on the opposite side.

Exceptions are to be found in patients who have had unilateral suppuration of severe grade in early years or who have had chronic suppurative disease.

In correspondence with the anatomic observations, roentgen examination has shown that asymmetric pneumatization of normal pyramids

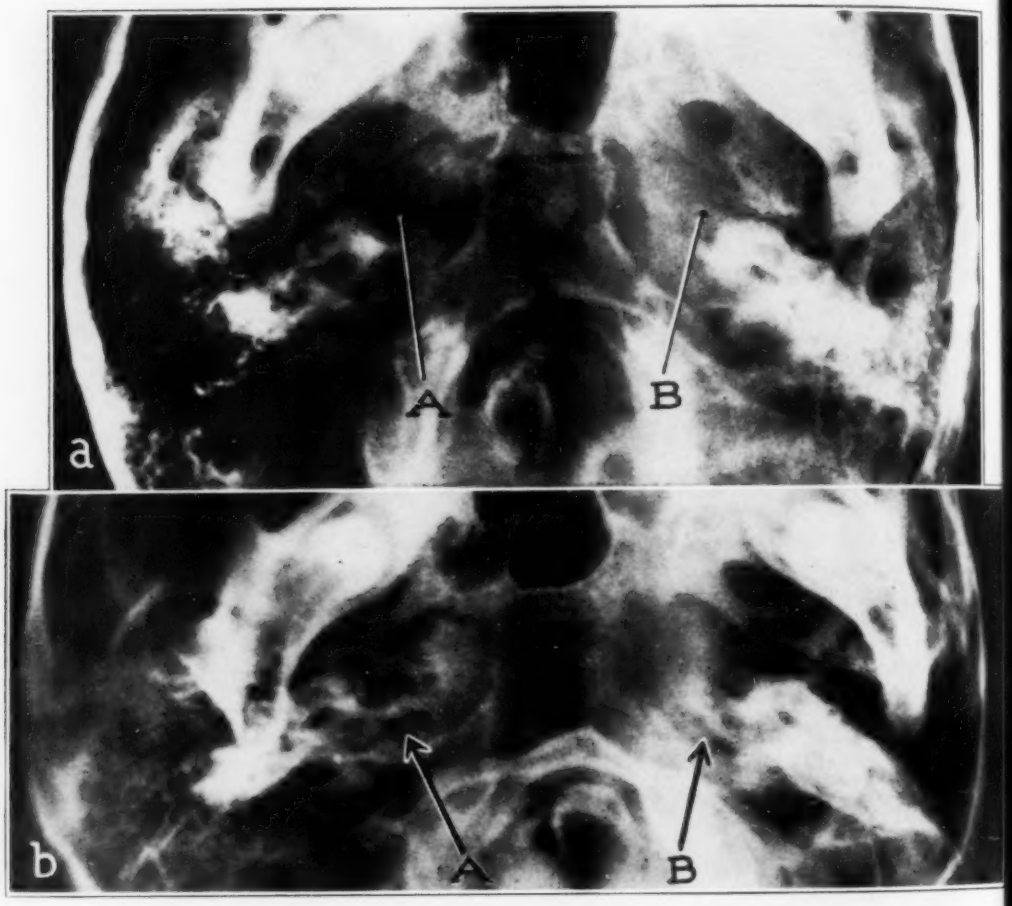

Fig. 15.—Axial view (*a*) showing pneumatization of the normal apex, *A*, while the diseased apex, *B*, shows increased density. A large closed abscess of the apex was opened by the intrapetrosal approach via the middle ear. The patient recovered. In *b* the normal apex, *A*, shows clearcut cell partitions. The diseased apex, *B*, shows marked contrast, the appearance suggesting breakdown of cells. A large abscess in the apex was opened by way of the middle ear and the carotid canal. The patient recovered.

is at least frequent. In cases of chronic suppuration the interpretation of the roentgenogram may be said to have difficulties and limitations the same as or similar to those that have been found in cases of chronic mastoid disease and is not to be discussed here.

In cases of acute suppuration in the pyramid roentgen study has a fairly definite value and also definite limitations.

The information of primary importance to be obtained roentgenographically is whether pneumatization is present. The findings on the normal side are essentially important as a basis for comparison, because in the absence of chronic suppuration or previous acute suppuration, pneumatization in the normal pyramid will be accompanied by some degree of pneumatization on the opposite side.

Early suppuration causes increased density on roentgenograms, with cell outlines usually still visible (fig. 15 *a*).

Late suppuration which has caused extensive destruction of bone produces decreased density on roentgenograms, with loss of bony trabeculae. In late phases with extensive breakdown of bone the whole apex may appear as a homogeneous area with less density than on the normal side in which pneumatization can be seen (figs. 7 *a* and 14 *b*). Extensive and prolonged suppuration in an apex may invade the sphenoid bone, producing osteomyelitis and clouding of the sphenoid sinus on roentgenograms (fig. 14 *b*).

Erosion of the cortex has frequently been found, usually associated with a general decrease in density and loss of cell outlines in the area. Such erosions are seen on roentgenograms only if they involve the region of the superior angle of the pyramid (figs. 7 *a* and *b*).

In general the roentgen findings serve to confirm the impression gained from symptoms and signs and to complete the clinical picture.

In the light of present knowledge careful clinical observation almost always gives reliable evidence as to the presence of suppuration in the pyramid, but the location of the diseased area is frequently obscure, and for this purpose a careful roentgen examination may be of invaluable assistance.

The decision as to whether surgical intervention is to be undertaken for acute suppurative disease of the pyramid depends on the clinical condition as a whole. The roentgen examination furnishes an indication for surgical intervention when there is definite evidence of extension or increasing destruction of bone,[5] because experience has shown that diffuse meningitis may then develop rapidly, but in such instances clinical symptoms are usually present also, particularly pain, which constitutes an important danger signal.

In cases of early suppuration, when there is increased density, the roentgen findings do not constitute a surgical indication, but they give confirmatory evidence as to the location of the diseased area.

When surgical intervention is indicated the information afforded by accurate roentgen studies as to the extent and distribution of pneumatization is frequently of invaluable assistance (fig. 7).

5. Nager, F. R.: Die Bedeutung der Roentgenuntersuchung bei den Eiterungen der Felsenbeinspitze, Acta radiol. **15**:475, 1934.

EDEMA OF THE LARYNX

A STUDY OF THE LOOSE AREOLAR TISSUES OF THE LARYNX

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Some time ago, wishing information on edema of the larynx, I was surprised to find that textbooks passed over the subject with scant attention and that the information which I wished was not readily available. I therefore decided to undertake my own investigation and have recorded the historical and experimental findings in this paper.

HISTORY

The existence of edema of the larynx has been known and observations made on it for centuries. The first recorded account of the condition appears to be that of Hippocrates,[1] who described a serious and a dangerous type of angina, sudden in onset and producing marked dyspnea but showing no signs of its presence when one looked into the throat. Hajek[2] pointed out that it was recognized by Aretaeus[3] and later by Cornelius Celsus,[4] who both described the symptoms but could not see anything in the living patient to account for them, although they saw the condition of the throat after death. Both included the condition among the anginas.

Medical observation and activity deteriorated rather than progressed during the following years, until the advent of Thomas Sydenham on the scene. Sydenham is considered the reviver of the Hippocratic method of study, and his anatomic and pathologic observations in the latter part of the seventeenth century made it possible for Hermann

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From the Department of Anatomy and the Department of Otolaryngology, School of Medicine, University of Pennsylvania.

1. Hippocrates Werke, translated from the Greek by J. F. C. Grimm, Glogau, H. Prausnitz, 1837.

2. Hajek, M., in Heymann, P.: Handbuch der Laryngologie und Rhinologie, Vienna, A. Hölder, 1898, vol. 1, p. 497.

3. Aretaeus Cappadox: De causis et signis acutorum et diuturnorum morborum libri quatuor, Oxoniae, typ. Clarendoniano, 1723, book 1, chap. 7.

4. Celsus, A. C.: De medicina, Florentina, Nicolao (di Lorenzo), 1478.

Boerhaave [5] and Gerald Van Swieten [6] to give the first description of edema of the larynx which was based on a sound anatomic and pathologic foundation. They described the swelling of the various parts of the larynx, with the changes in the lumen, showing how these changes could obstruct breathing and produce asphyxia. Van Swieten described the swelling as a cold, pale, watery tumor with signs of inflammation.

Late in the seventeenth century Bichat began to publish various articles on anatomy and considerable material on laryngeal edema, but his promising career was cut short by his death in 1802 at the early age of 31. In spite of his youth, he has been called the father of descriptive anatomy and was the first to give detailed descriptions of the tissues of the body in health and disease.[7] He appears also to have been the first to produce laryngeal edema experimentally,[7a] as referred to by Hajek [2] and Charazac.[8] He made incision under the tongue and pierced the epiglottis of dogs. One of the dogs died the following day from a serous angina "exactly the same as that which suffocates patients and located in the aryepiglottic folds."

It was Bayle [9] who first recognized the true character of edema of the larynx, realizing that it was a serous infiltration of the submucous tissues. He did not, however, recognize a noninflammatory as well as an inflammatory type of edema. Bayle, too, seemed to feel that death in such cases is due to a spasmodic condition of the lungs and not to laryngeal obstruction. Despite these errors, his studies were of great importance. His first paper with his observations was read in 1808, but its importance was not recognized until later, when his paper was published in part in 1817,[9a] and then more fully, in 1819, after his death.

The first to write of palpation with the finger in examining patients with laryngeal edema was Finez de Seissel,[10] who in 1813 published a paper on edema of this part. Even though he suggested this method of examination, he stated that he felt that it was of no use in the diagnosis in the case which he reported. Finez also appears to have been the first

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5. Boerhaave, H.: Aphorismi de cognoscendis et curandis morbis in usum doctrinae domesticae digesti, Frankforti ad Moenum, 1710; cited by Hajek.[2]

6. Van Swieten, G.: Commentar, in Boerhaave, H.: Aphorismi de cognoscendis et curandis morbis, ed. 3, Lugdum Batavorum, J. vander Linden, 1722.

7. Bichat, F. X.: (*a*) Traité d'anatomie descriptive, Paris, Gabon & Cie, 1802, vol. 2; (*b*) Traité des membranes en general et de diverse membranes en particulier, Paris, Richard, Caille & Ravier, 1799-1800, vol. 8.

8. Charazac, J.: Etude sur l'œdème du larynx (œdème de la glotte), Thesis, Bordeaux, no. 33, Paris, O. Doin, 1885.

9. Bayle, G. L.: (*a*) in Dictionnaire des sciences médicales, Paris, Crapart & Panckoucke, 1817, vol. 18, p. 505; (*b*) Mémoire sur l'œdème de la glotte, ou angine laryngée œdémateuse, Nouv. j. de méd., chir., pharm., etc. **4**:3, 1819.

10. Finez de Seissel, B.: Quelques observations chirurgicales receuillies à l'Hotel-Dieu à Lyon, Thesis, Paris, no. 78, 1813.

to propose the introduction of a flexible rubber tube into the larynx in such cases to prevent asphyxia.

In 1815 Tuillier [11] read his "Essay on Oedematous Angina of the Larynx" before the Faculty of Medicine in Paris, apparently knowing nothing of Bayle's paper, and was the first to prove by palpation with the finger the presence of the swelling in the aryepiglottic folds. The existence of this aryepiglottic swelling had been pointed out many years before by Morgagni.[12] The latter did not, however, describe any symptoms caused by the condition nor recognize the seriousness of its presence. When death occurred he considered it due to a "serous stroke" instead of to the mechanical obstruction and asphyxia caused by the swelling.

Many others wrote of edema of the larynx and various swellings in this area causing death. There were case reports of sudden asphyxia which was cured by tracheotomy,[13] and others reported deaths due to refusal to submit to the operation. It is reported that Dr. Dick advised tracheotomy for George Washington during his last illness but was overruled by the other physicians, who advocated bleeding instead.[14] Bleeding appears to have been the main treatment in those days, and as a result many died who could probably have been saved by tracheotomy. It is evident in going over the literature also that in the early days of knowledge of laryngeal obstruction little attempt was made to differentiate between obstruction developing in the larynx itself and conditions in which the obstruction was above, such as peritonsillar or retropharyngeal abscess, Ludwig's angina or any other infectious process developing in the area. The various types of edema were not recognized, nor was any effort made to classify them, although Cornelius Celsus,[4] who lived almost two thousand years ago, made note of an involvement of the throat with which inflammation did not appear and yet the patient could hardly breathe. Various others among the early authors mention such cases, but the difference seems not to have been recognized when it came to treatment. Bayle did state that "edematous laryngitic angina is either primary and essential or secondary and symptomatic," but, as Hajek pointed out, nowhere did he show that edema may appear independent of all inflammation or irritation.

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11. Tuillier, M.: Essai sur l'angine laryngée œdémateuse, Thesis, Paris, no. 81, 1815.

12. Morgagni, G. B.: De sedibus et causis morborum, Venetiis, ex. typog., Remondiniana, 1761; cited by Hajek.[2]

13. Ferrière: Sur l'angine œdemateuse, J. de méd., chir., pharm., etc. **42**:248, 1784. Vidal: De la bronchotomie dans l'esquinancie inflammatore et suffocante, ibid. **38**:358, 1772. Houdry: Sur une angine œdemateuse prête à suffoquer le malade, ibid. **41**:483, 1784.

14. Valentin, L.: Recherches historiques et pratiques sur le croup, Paris, Le Normant, 1812.

After the middle of the nineteenth century observations of the "apparently" noninflammatory edema became more frequent, and numbers of papers were published regarding this type, although none admitted the total absence of inflammation. Bouillard [15] said:

> I did not assume that the edema of the glottis, like all other dropsies, could not result from hypercriny [sic] or from an obstacle to venous circulation. It is only sure that edemas of this nature are little known and that Bayle himself, whom nobody can accuse of having seen everywhere nothing but inflammation and irritation, has spoken of edema of the glottis as a consequence of acute or chronic inflammation of the larynx.

Rayer [16] admitted that a purely serous exudate might take place in the loose cellular tissues of the larynx in certain dropsies after involvement of the heart or lungs but stated that he had never seen one. Andral [17] said: "This disease can only be the result of inflammation of the larynx, but, let us add, we must face the fact of its existence without it."

So it goes through many papers, with none of the authors getting to the facts and all convinced that there is always an inflammatory background whether it can be found or not. The literature abounds in case reports with the cause of the edema ascribed to various infections localized at points adjacent to the larynx. Practically all the acute infectious diseases, such as "laryngeal erysipelas," syphilis, tuberculosis and diphtheria, and diseases due to administration of iodides, inhalation of steam and trauma from foreign bodies were mentioned, but it was not until after Quincke's description of angioneurotic edema in 1882 [18] that Strübling [19] described "angioneurotic edema of the throat" and opened the way for a more complete understanding of the condition. Since then the possible occurrence of the condition without any preexisting inflammation has been generally recognized.

Probably the most important item in causing the delay in the proper understanding in many cases was the inaccessibility of the area to examination. It was not until the use of the laryngeal mirror was popularized that physicians were able to examine their patients properly. Efforts were made at various times during several centuries to devise instruments for this purpose, but none seem to have gained favor until the middle of the nineteenth century, and it is only from that time

15. Bouillard, J. B.: Oedeme de la glotte, in Dictionnaire de médecine et de chirurgie pratiques, Paris, Gabon [and others], 1834, vol. 12, pp. 112-121.

16. Rayer, P., in Dictionnaire de médecine et de chirurgie pratiques, Paris, Gabon [and others], 1836, vol. 15, p. 241.

17. Andral, G.: Coure de pathologie interne, Leçons de path. int. **1**:304, 1836.

18. Quincke, H.: Ueber akutes umschriebenes Hautödem, Monatsh. f. prakt. Dermat. **1**:129, 1882.

19. Strübling, P.: Ueber angioneurotisches Larynxoedem, Monatschr. f. Ohrenh. **20**:314 and 376, 1886.

forward that the study of the larynx has been on a sound basis. According to Garrison [20] in his "History of Medicine," the dentist's oral mirror was mentioned almost two thousand years ago by Celsus, who called it a "specillum." During the seventh century Paul of Aegina devised his "glossotochus" for examining the mouth and pharynx. According to Elsberg [21] in his excellent review of the history of these instruments, various physicians, including Ambrose Paré, reported similar devices, none of which gained favor. In 1807 Bozzini [22] wrote of his "light conductor," in which he used the idea of illumination and reflection of light. In 1829 Babington [23] showed his "glottiscope" to the Hunterian Society of London, and it is said that he developed this instrument without any knowledge of the previous efforts of others.[24] It was not until after the middle of the century that any real progress was made. In 1855 Manuel Garcia,[25] a Spanish singing teacher living in London, reported his method of studying the larynx with mirrors. He used these to study the movements of his own larynx, as well as to study those movements in others. This method was popularized by Czermak [26] and Türck,[27] who both published their papers in 1858, Czermak on March 27 and Türck on June 26. From this time on the use of mirror laryngoscopy spread, and it is from this time that the more complete knowledge of the larynx dates.

PHYSIOLOGIC NATURE OF EDEMA

Hajek [2] seems to have been the first observer to call attention to the distinct difference in the material which infiltrates the tissues in edema, describing observations at autopsy: In certain cases clear fluid readily flowed out of the tissues after simple incision and gentle

20. Garrison, F. H.: History of Medicine, Philadelphia, W. B. Saunders Company, 1924.

21. Elsberg, L.: Meaning and History of Laryngoscopy and Kindred Methods of Examination, Philadelphia M. Times **4**:129, 1873.

22. Bozzini, P.: Der Lichtleiter oder Beschreibung einer einfachen Vorrichtung und ihrer Anwendung zur Erleuchtung innerer Höblen und Zwischenräume des lebenden animalischen Körpers, Weimar, 1807; cited by Windsor.[24]

23. Babington, B.: Glottiscope, London M. Gaz. **3**:555, 1829.

24. Windsor, T.: On the Discovery of the Laryngoscope, Brit. & For. Med.-Chir. Rev. **31**:209 (Jan.-April) 1863.

25. Garcia, M.: Observations on the Human Voice, Proc. Roy. Soc., London **7**:399, 1854-1855.

26. Czermak, J.: Ueber den Kehlkopfspiegel, Wien. med. Wchnschr. **8**:196, 1858.

27. Türck, L.: Der Kehlkopfrachenspiegel und die Methode seines Gebrauches, Ztschr. d. k.-k. Gesellsch. d. Aerzte zu Wien **14**:401, 1858; Ueber Gewinnung Kehlkopf Spiegelbilder und über einige Kunstgriffe bei der laryngoscopischen Untersuchung, ibid. **15**:817, 1859.

pressure; in others a seropurulent or purulent exudate appeared, which was more gelatinous. Hajek also recognized that there was an inflammatory as well as a noninflammatory type of edema, that it occurred in various infectious processes about the throat or sometimes at a distance and that it occurred with renal, cardiac and pulmonary conditions.

The fact that laryngeal obstruction in some cases could be relieved by scarification and in others could not brought about the realization that the cause of this lies in the variation in the character of the fluid in the tissues, a matter of coagulability of the fluid which depends on the concentration of protein in the fluid. In spite of considerable work having been done, comparatively little is known of the tissue fluids. According to the theory of Starling,[28] the fluid which enters the tissues under normal conditions is practically protein free. Inquiry, vasodilation, inflammatory reactions and various other conditions may alter the capillary permeability to such an extent that, in addition to serum proteins, even blood cells may escape into the tissues.[29]

According to Peters and Van Slyke,[30] even less is known about the nature of the proteins in the tissue fluids than about their concentration. Concerning the site of origin of the plasma proteins, they state [31] that evidence is not available except for fibrinogen, which has been shown to be formed in the liver.[32] The possibility that this knowledge might have clinical bearing on the treatment has been investigated, and Full [33] and McLester,[34] among others, expressed themselves as somewhat encouraged, although their investigations seem inconclusive. Foster and Whipple [32a] showed that destructive and inflammatory lesions of any kind are the normal cause of increase in

28. Starling, E. H.: On the Absorption of Fluids from Connective Tissue Spaces, J. Physiol. **19**:312, 1895-1896.

29. Krogh, A.: The Anatomy and Physiology of the Capillaries, New Haven, Conn., Yale University Press, 1922.

30. Peters, J. P., and Van Slyke, D. D.: Quantitative Clinical Chemistry, Baltimore, Williams & Wilkins Company, 1932, vol. 1, p. 697.

31. Peters and Van Slyke,[30] p. 396.

32. (*a*) Foster, D. P., and Whipple, G. H.: Fibrin Values Influenced by Cell Injury, Inflammation, Intoxication, Liver Injury and Eck Fistula: Notes Concerning the Origin of Fibrinogen in the Body, Am. J. Physiol. **58**:407, 1922. (*b*) Whipple, G. H., and Hurwitz, S. H.: Fibrinogen of the Blood as Influenced by Liver Necrosis of Chloroform Poisoning, J. Exper. Med. **13**:136, 1911. (*c*) McMaster, P. D., and Drury, D. R.: The Source of Fibrinogen, Proc. Soc. Exper. Biol. & Med. **26**:490, 1929.

33. Full, H.: Bestimmung des Fibrinogengehalte des Blutes als Leberfunktionsprüfung, Verhandl. d. deutsch. Kong. f. inn. Med. **33**:478, 1921.

34. McLester, J. S.: Diagnostic Value of Blood Fibrin Determinations, with Special Reference to Diseases of the Liver, J. A. M. A. **79**:17 (July 1) 1922.

the formation of the fibrinogen by the liver and that even in the presence of severe hepatic damage the level of fibrinogen may be increased in response to injury. The effect of hepatic destruction on the production of fibrinogen, then, is noted only in cases in which the damage to the liver has become so severe that it can no longer produce what is necessary.

Inflammatory edema is largely a vascular phenomenon, which seems primarily due to the stimulus of substances liberated from dead or injured tissues.[35] Great dilatation of the arterioles and capillaries occurs, probably due to paralysis by toxins which have been formed. Many capillaries which have been closed open because of loss of tone, and the permeability of their walls increases, allowing clear fluid to escape into the tissues. As more fluid is lost from the capillaries, the red cells begin to form clumps, and the slowing of the blood stream is increased; the leukocytes become adherent to the capillary walls and make their way through into the tissues, where they, together with antibodies which have been poured out with the plasma, attack and liquefy the bacteria. Schade and his associates[36] have shown that material from abscesses, even if the cells are removed by a centrifuge, may contain as much protein as serum or more. It is presumed that in the case of abscesses, however, a large part of the protein is derived from broken-down tissue and only a part from the blood stream.

Fluids from patients with cardiac or renal edema do not clot, and this is evidence that they contain no appreciable amount of fibrinogen. Indeed, it has been shown by Salvesen and Linder[37] that there was only 0.05 to 0.35 per cent total protein in the fluid from the edema in 1 case of nephrosis and 3 of cardiac decompensation. Fahr and Swanson[38] found only traces of globulin in such fluids. In angioneurotic edema, on the other hand, Govaerts[39] found the fluid to contain larger amounts of protein, the globulin content being almost as high as in the patient's plasma. He was able, also, to detect traces of fibrinogen. He inferred from this that angioneurotic edema is associated with dis-

35. Wright, S.: Applied Physiology, London, Oxford University Press, 1934, p. 268.

36. Schade, H., and others: Weitere Untersuchungen zur Molekolarpathologie der Entzündung: Die Exsudate, Ztschr. f. d. ges. exper. Med. **49**:334, 1926.

37. Salvesen, H. A., and Linder, G. C.: Observations on the Inorganic Bases and Phosphates in Relation to the Protein Content of the Blood and Other Body Fluids in Bright's Disease and Heart Failure, J. Biol. Chem. **58**:617, 1923.

38. Fahr, G., and Swanson, W. W.: The Effect of Osmotic Pressure of the Plasma Proteins, Am. J. Physiol. **76**:201, 1926; Quantities of Serum Albumen, Globulin and Fibrinogen in Blood Plasma in Acute and Chronic Nephropathies, Arch. Int. Med. **38**:510 (Oct.) 1926.

39. Govaerts, P.: Etude de la composition du liquide d'œdème dans un cas "d'œdème de Quincke," Compt. rend. Soc. de biol. **99**:339, 1928.

turbances, probably vasodilator, which render the capillary walls more permeable.

Such evidence as is available, then [according to Peters and Van Slyke,[30] concerning the protein content of tissue fluids in disease], tends to support the theory of Starling and favors the hypothesis that renal and cardiac oedemas are not due to any change in the permeability of the capillaries.

The deficit following either proteinuria or malnutrition falls, as a rule, chiefly on the albumin factor and is accompanied by a tendency to edema. The edema of degenerative Bright's disease appears certainly, and the edema of the various malnutritional states, probably, to be due to an albumin defect in the blood plasma.[40]

In attempting to determine the cause of the sudden edema in cases of allergy, considerable work has been done with paraphenylendiamine, which has the same action as histamine on the capillaries but not so severe. Dubois and Vignon [41] were the first to point out that after its injection into dogs edema of the head and neck developed, with, sometimes, an exophthalmos. Tainter and Hanzlik,[42] Gibbs [43] and Nemours [44] also have worked with the drug, using rabbits and cats. The effect was similar, the vessels of the head being decidedly more involved. The larynx became markedly edematous, and the animals died of asphyxia unless tracheotomy was performed, the latter prolonging life for some time. The edematous areas when incised did not collapse, and the appearance was likened by Gibbs to that of an incised nasal polyp. Gibbs showed that the increased permeability was not due to any action of the central nervous system and was independent of it, as the same effect was observed in decerebrate animals. Electrical stimulation of the superior cervical ganglion delayed the development of the edema on the stimulated side, probably by lessening the concentration of the drug. Tainter and Hanzlik confirmed this observation and also showed that vasodilator drugs hasten the effect and vasoconstrictor drugs delay it. Ligation of the carotid arteries before injection prevents the drug from reaching the head and edema does not develop. Nemours confirmed the findings of the others and also demonstrated the presence of eosinophilic cells in the edematous tissue. These were

40. Krogh,[29] p. 696.

41. Dubois, R., and Vignon, L.: Etude préliminaire de l'action physiologique de la para- et de la metaphénylene diamine, Arch. de physiol. norm. et path. **2**:255, 1888.

42. Tainter, M. L., and Hanzlik, P. J.: The Mechanism of Edema Production by Paraphenylene Diamine, J. Pharmacol. & Exper. Therap. **24**:179, 1925.

43. Gibbs, O. S.: The Edema of Para-Phenylene Diamine, J. Pharmacol. & Exper. Therap. **20**:221, 1923; The Relation of the Edema of Para-Phenylene to General Edema, ibid. **40**:65, 1931.

44. Nemours, P. R.: Experimental Edema of the Larynx Produced by Paraphenylene Diamine, Ann. Otol., Rhin. & Laryng. **41**:857, 1932.

not present in the control specimens, and their presence increased the similarity of the picture to that of allergy.

It has been frequently noted that certain nonantigenic substances, such as acetylsalicylic acid, in some cases produce sudden laryngeal edema. Landsteiner and Van der Scheer [45] in their work seem to have answered the question how this can occur. They found that a crystalloid united with a protein carrier acts as an antigenic agent, that crystalloids in conjunction with protein injected into experimental animals cause the formation of an antiserum combining anticrystalline and antiprotein functions.

SYMPTOMS

The onset of symptoms of laryngeal edema may be abrupt and without preliminary signs of any sort, and the symptoms may assume alarming proportions in a few minutes. In other cases some warning may be given through the presence of local factors which, to the laryngologist, suggest that the symptoms should be watched for.

Hoarseness may or may not be present. Cough is usually present but of varying severity. There are local sensations of dryness, heat and tickling. As obstruction increases there is wheezing; the breathing becomes stridorous, and asphyxia develops unless active measures are taken. There may also be difficulty and pain on swallowing, and the pain may be referred to the ear. As breathing becomes severe there is indrawing of the suprasternal notch and the abdominal muscles due to the excessive effort to pull in sufficient air. These symptoms may accompany laryngeal edema of whatever origin, but if the case is one of angioneurotic edema there may be also gastrointestinal symptoms, vomiting, abdominal pain and diarrhea. Occasionally urethral and vesical irritation appears. If the case is one in which the primary cause was an inflammatory condition about the throat, the symptoms of this condition also will be present. Cardiorenal and pulmonary diseases, of course, give their symptoms in the conditions arising from them.

With inflammatory conditions the onset is usually more gradual than with angioneurotic, and the possibility of the occurrence of edema should be borne in mind in the care of allergic patients.

Examination of the throat with edema of inflammatory origin may reveal any one of the conditions which may be the exciting cause. In some cases, because of the accompanying condition, it is almost or quite impossible to make a proper laryngeal examination because of limitation of movement of the jaw or swelling of various parts of the pharynx or tongue. However, when it is possible to insert a mirror or laryngoscope the picture depends on the part of the laryngeal

45. Landsteiner, K., and Van der Scheer, J.: On Specificity of Serological Reactions with Simple Chemical Compounds (Inhibition Reactions), J. Exper. Med. **54**:295-305, 1931.

structure involved. The epiglottis is much swollen, and the space between it and the base of the tongue may be completely filled with a swollen and glistening mass. One or both of the aryepiglottic folds may be greatly swollen, and these may become so large that they can be seen projecting as rounded smooth masses above the base of the tongue as soon as the latter is depressed. The space between these folds may be so narrowed that further examination is impossible. If the edema is inflammatory in origin the swellings are pinker; if it is angioneurotic they are paler and have more the appearance of a glistening nasal polyp. In the latter event, too, they have a firmer appearance than edema of inflammatory or cardiorenal origin.

CAUSATION

The causes of edema of the larynx may be outlined as follows:

I. Local causes
  A. Noninfectious conditions
    (*a*) In the larynx
      1. Irritation by a foreign body
      2. Fracture, wounds of larynx or injuries at birth
      3. Inhalation of steam
      4. Inhalation of irritating gases
      5. Contact with corrosive liquids
      6. Contraction of scar tissue following operation
    (*b*) In tissues adjacent to the larynx
      1. Wounds or foreign bodies involving the base of the tongue or the pharynx
      2. Neoplasms or scars in adjacent tissues causing interference with venous return
      3. Enlargement of the thyroid
      4. Exposure to roentgen rays or radium
  B. Infectious conditions
    (*a*) In the larynx
      1. Ulceration from tuberculosis, syphilis, chronic laryngitis, typhoid fever, smallpox or gonorrhea (rarely)
    (*b*) In tissues adjacent to the larynx
      1. Pharyngeal involvement of acute infectious diseases
      2. Tonsillitis and peritonsillar abscess
      3. Pharyngitis and retropharyngeal abscess
      4. Lingual tonsillitis
      5. Cervical adenitis
      6. Ludwig's angina
      7. Erysipelas
      8. Cellulitis of the neck

II. General causes
  A. Allergy
  B. Cardiac disease
  C. Renal disease
  D. Pulmonary disease
  E. Medication (iodides)

TREATMENT

The treatment of laryngeal edema depends in part on the condition underlying the local involvement, although in all cases, irrespective of causation, the basic consideration is to open and keep open the airway. In general the patient should be in bed in a room with moist air. (A steam kettle with tincture of benzoin compound is useful.) Vocal rest and absolutely quiet surroundings are important. If the patient can swallow and is not too debilitated, catharsis is indicated and hot packs may be used.

Local spraying with epinephrine, 1 : 100, chilled, or even a weaker solution may be of great aid in reducing the swelling. Naturally, attention to any local condition in the throat which might be the primary cause is called for. Scarification of the edematous areas is of little use except in conditions of cardiac or renal origin in which the fluid in the tissues does not coagulate. In most of the other cases scarification may only tend to increase the inflammation and give little if any relief. Cold compresses may be helpful, and cracked ice in the mouth may give relief. No matter what the origin or what other measures are taken, when the condition is severe the physician should be prepared to do emergency tracheotomy. Inhalation of oxygen may carry the patient over a critical point. The patient's strength should be sustained by whatever measures seem most suitable.

In cases of angioneurotic edema hypodermic administration of epinephrine, 1 : 1000, in 0.5 or 1 cc. doses will in most cases give rapid relief. Local spraying with chilled epinephrine, 1 : 100, as mentioned, is helpful. Scarification and application of medication by means of swabs is unwise. Absolute silence should be enforced, the patient not being allowed to utter a word. The patient should be constantly watched and facilities always at hand for quick tracheotomy. In most cases the condition will spontaneously subside, and as soon as possible after this tests should be made to determine the exciting agent. Jackson [46] stated that sometimes the signs seen in the laryngeal mirror are a better index to the condition than is the dermal reaction to the test. Focal infections should be looked for in the nose and throat, but unless indications are definite, operation should not be rushed. All observers seem to point out the great need for a complete history, going thoroughly into the patient's habits and environments. In so far as possible all sources of, or causes for, worry should be removed, as it appears that worry and mental stress are definite factors in the precipitation of some attacks. Jackson advocated a thorough general

46. Jackson, C., in Jackson, C., and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929, p. 836.

examination, even with endocrine investigation, but stated the belief that whatever endocrine imbalance appears is not a causative factor but a result of faulty habits of life which have been involved in the condition and that the imbalance will clear up after the patient is put on a proper regimen.

Family history should be looked into. Heredity is an important factor, Osler [47] having reported angioneurotic edema in 19 of a family of 39 in five generations, at least 2 of whom died of the condition. J. R. and T. R. Crowder [48] reported 27 among 63 persons in five generations, half of whom died of the condition.

It is well to caution against the indiscriminate use of antitoxins or the administration of serums of any kind to persons who are known to be allergic or who have a family history of allergy and always to be cautious with patients to whom a serum has been administered previously. If it is essential that a serum be given, desensitizing doses should be injected and a careful watch kept during the process.

It might be well also to call attention again to the need for facilities for performing tracheotomy in all serious attacks.

Certain angioneurotic patients die suddenly, and it has been suggested by Theisen [49] that some of these deaths may be due to edema involving the cardiac or respiratory center in the brain.

EXPERIMENTAL WORK

The principal experimental work on the loose areolar tissues of the larynx in an endeavor to find the limits to which edema might extend has been done by Sestier,[50] Hajek [2] and Logan Turner.[51] The first experimental work was reported by Bichat [7a] when he produced edema in the epiglottis of a dog, as mentioned earlier in this paper. This, however, gave little information as to the extent to which the edema might spread. Sestier first attempted to determine the situation by seeing where the mucosa would strip off readily. He later performed his classic experiment, in which he ligated the left carotid artery in a cadaver and injected about 2 quarts (1.9 liters) of water into the right. Hajek in his work injected directly into the submucous tissues,

47. Osler, W.: Hereditary Angioneurotic Edema, Am. J. M. Sc. **95**:362, 1888.

48. Crowder, J. R., and Crowder, T. R.: Five Generations of Angioneurotic Edema, Arch. Int. Med. **20**:840 (Dec.) 1917.

49. Theisen, C. F.: Acute Laryngeal Edema, Ann. Otol., Rhin. & Laryng. **33**: 487, 1924.

50. Sestier, F.: Traité de l'angine laryngée œdémateuse, Paris, J. B. Baillière, 1852.

51. Turner, A. L.: The Submucous Areolar Tissue of the Larynx and Its Significance in the Spread of Edema, Edinburgh M. J. **11**:417, 1902.

as did Logan Turner. The present work confirms, in the main, their findings, but certain conflicts will be pointed out.

This work was done through the courtesy of Dr. Oscar Batson and the department of anatomy of the Graduate School of Medicine of the University of Pennsylvania.

The specimens consisted of 15 infant and 4 adult larynxes. A block removal was made of the tissues of the neck anterior to the vertebral muscles, so that each specimen consisted of the tongue, the soft palate, the entire pharynx, the larynx, the trachea down to about the fourth or fifth ring and upper part of the esophagus. Adult specimens were all recent, and infant specimens were from newborn babies,

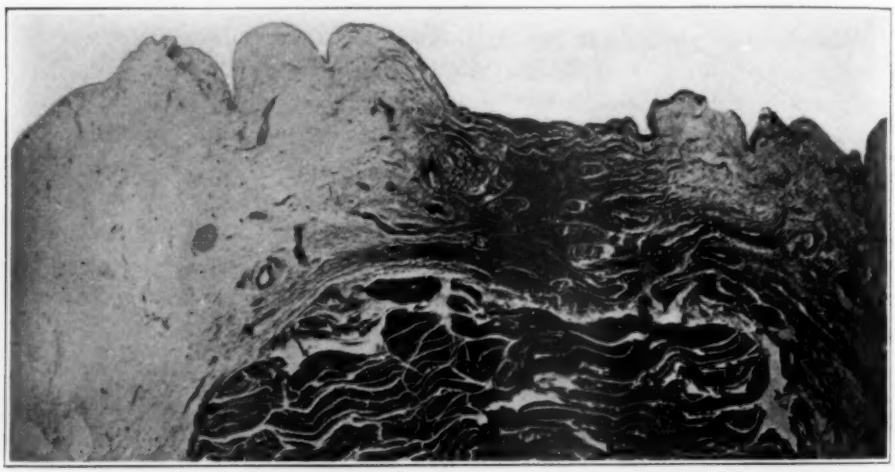

Fig. 1.—Section of tissue from over the cricoid of an infant, showing the dense fibrous barrier in the midline. This specimen was injected from one site on the left side, and the fluid was held up by this barrier until, on further injection it passed around in front of the epiglottis and traveled backward to meet the cricoid barrier on the right side. (Kaiserling's solution was injected.)

the majority of which had been frozen. The frozen specimens were thawed slowly, and none of the series was heated at any time. Some of the injections were made with Kaiserling's solution no. 3, a mixture of potassium acetate, glycerin and water. Others were made with a 10 per cent solution of gelatin colored with water blue. The specimens were split up the midline of the posterior pharyngeal wall, and injections were made directly into the submucosa.

In the infants the injections were in most cases made under the mucosa of the pharyngeal wall and the entire injection carried out through this one site. A flattened swelling at once appeared and extended forward to the lateral pharyngoepiglottic fold, where it was

temporarily held in check, the fluid meanwhile almost obliterating the piriform sinus. At the same time, the aryepiglottic fold became edematous to a marked degree, and the fluid found its way downward through the submucous tissues over the esophageal aspect of the cricoid, but the spread here was abruptly checked in the midline. The swelling extended downward for a short distance below the lower margin of the cricoid and was almost baglike in appearance.

The presence of this barrier of fibrous tissue in the midline over the cricoid seems to be described here for the first time. Neither Hajek

Fig. 2.—Infant larynx injected through the left side with Kaiserling's solution, showing the median barrier over the cricoid to be sufficiently dense to hold the fluid in check, although enough force was used to force it forward around the front of the epiglottis and to involve the aryepiglottic fold of the opposite side.

nor Turner mentioned it; indeed Turner definitely stated that the fluid readily passes from one side to the other over the cricoid.

By injection of further material through the same site the whole of the lateral edematous area became more cup shaped, the fluid breaking through the lateral pharyngoepiglottic fold, where it had encountered some resistance, and passing on after a short delay at the lateral glossoepiglottic fold to enter the vallecula. During this development the fluid further expanded the aryepiglottis fold and passed up on the anterior surface of the epiglottis but stopped abruptly at the margin

of this structure. The vallecula was obliterated as the fluid was again held up by the median glossoepiglottic fold. This fold contains more fibrous tissue than the lateral folds and provides more resistance to the passage of the fluid. Even when fully injected this fold will be outlined by a depression in the midline over the edematous epiglottis. The entire anterior surface of the epiglottis becomes edematous, and the fluid passes forward on the base of the tongue almost as high as the tip of the epiglottis. This observation also seems to vary from

Fig. 3.—Larynx of an adult Negro injected with Kaiserling's solution; marked edema over the cricoid stopping abruptly in the midline; piriform sinus and aryepiglottic fold much involved, with beginning edema over the epiglottis. The side of the epiglottis is being bent inward by the pressure of the edema.

the findings of previous observers, as they stated that the edema would not spread farther than halfway to the level of the epiglottic tip.

As further fluid is injected, the resistance of the median glosso-epiglottic fold is broken down, and the vallecula on the opposite side is obliterated by an edematous mass which spreads all over the anterior surface of the epiglottis and upward on the base of the tongue. Still further injection through the original site forces the fluid through

the submucous tissues of the opposite side, the process already described being repeated but in reverse order, until the fluid meets, traveling in annular fashion, the dense fibrous barrier in the midline over the cricoid.

As is shown in figure 4, when the injection is carried out from behind and the aryepiglottic folds involved, first there tends to be an incurvation of the lateral margins of the epiglottis, which in the infant exaggerates the natural V shape of that structure and in the adult causes it to approximate the infantile V type. On the other hand, it

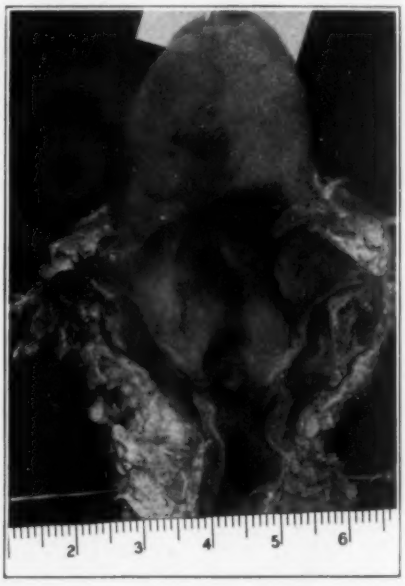

Fig. 4.—Infant larynx injected with Kaiserling's solution from four points, from either side of the pharynx below and from either side anteriorly above the valleculae; exaggeration of the infantile V shape of the epiglottis; abrupt limitation of the edema at the epiglottic rim; close approximation of the aryepiglottic folds; marked edema over the esophageal aspect of the cricoid, with the median barrier outlined as a groove.

was found that if the injections were made so as only to affect the valleculae and the anterior surface of the epiglottis the latter was broadened, was less curved than normal and was not forced backward over the airway. This has already been pointed out by Turner.[51]

On opening the larynx it was found that the injected material failed to involve the under surface of the epiglottis at any point, because the mucosa was densely adherent. The aryepiglottic folds were completely filled, as was all the space between the laryngeal mucosa, the thyrohyoid membrane, the thyroid and the cricoid cartilage. The ven-

tricle was obliterated, and its opening into the larynx was outlined as a mere slit. There was practically no edema over the true cords, although they showed rounded edges.[52] There was some involvement of the submucous tissues of the ventricular bands, particularly on the upper aspect, where they are looser and more abundant. Both true cords and ventricular bands could be readily identified and were not

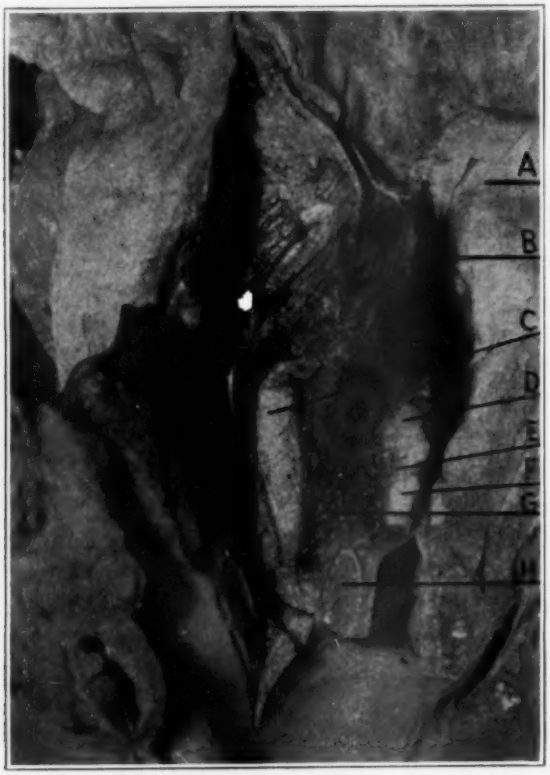

Fig. 5.—Adult larynx injected with gelatin colored with water blue; *A*, epiglottis; *B*, aryepiglottic fold; *C*, thyroid cartilage; *D*, ventricular band; *E*, ventricle obliterated; *F*, true cord; *G*, infiltration of underlying tissues forcing cords medially; *H*, cricoid cartilage.

lost in the edematous mass. On cross section the tissues forming these structures were shown to be practically uninvolved (fig. 5).

52. Clinically edema of the true vocal cords is rare but occasionally occurs, producing rounding of the edge or, when circumscribed, resulting in sessile or pedunculated polyps. When this occurs it is due to involvement of Reincke's space, which is "a potential microscopic space, probably consisting of a basement membrane of colloidal material lying beneath the epithelial lining of the cords and extending

Sestier, Hajek and Turner all found little submucous areolar tissue over the ventricular bands and practically none over the true cords. They all realized that obstruction occurring in this area is due to these structures being forced medially en masse by infiltration of the underlying tissues, though considerable swelling may occur on the upper aspect of the ventricular bands. Sestier found actual infiltration of fluid between the fibers of the thyroarytenoid muscle.

In none of the specimens could edema be demonstrated in the area below the true cords.

One specimen was injected before being split down the midline of the pharynx, and the fluid was found limited to the side of the pharynx injected.

These findings confirm the work of previous observers in the main, but two new facts are presented:

1. A dense and definite fibrous band holds down the mucosa along the midline over the cricoid cartilage on its esophageal surface, running in a vertical direction.

2. Submucous areolar tissue on the base of the tongue extends upward as high as the tip of the epiglottis.

CONCLUSIONS

While experiments on the cadaver cannot exactly reproduce what occurs in the living subject, they can undoubtedly give a rather accurate idea of the extent to which edema of the larynx may extend. They seem to indicate that edema may be localized between two adjacent condensations of fibrous tissue, represented by the barriers which have been pointed out. Certain chemical or physiologic effects of the fluids may develop in these tissues in disease which might lessen the efficiency of these condensations as barriers to the spread of involvement, as compared with their efficiency in checking the spread of the fluid in these injections. Certain types of edematous fluid may spread more rapidly than others because a difference in the protein content affects the diffusibility. Various factors such as these make it difficult to evaluate clearly the clinical importance of these particular findings. Localized edema is known, however, to occur in various parts of the larynx, and that many times in areas which might be limited by the barriers here described. So far as I have been able to determine, however, no clinician has observed unilateral edema over the esophageal surface of the cricoid. Whether this is because it has been hidden by edema over the arytenoid areas I do not know, but it

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from the anterior extremity only to the tip of the vocal process." Lederer, F. L.: Diseases of the Ear, Nose and Throat, Philadelphia, F. A. Davis Company, 1938, p. 568.

seems likely, as involvement of this area would almost surely be accompanied by edema over the arytenoid area and the aryepiglottic fold of that side.

These experiments indicate also that if the edema involved only the valleculae and the anterior surface of the epiglottis, there would be little interference with breathing and probably few symptoms other than a sensation of a mass in the throat. It is possible, however, that with the broadening of the surface of the epiglottis and the consequent interference with close approximation of the aryepiglottic folds there might be some difficulty in completely closing the airway when swallowing and fluids might trickle down into the larynx. Such a localization might follow involvement of the lingual tonsil or ulcerations of the epiglottis.

The results indicate, too, that with infections of the tonsil or the lateral pharyngeal wall when edema arises it may extend downward into the piriform sinus and from there extend into the aryepiglottic fold. Edema of one aryepiglottic fold might cause some respiratory difficulty but would not cause asphyxia; however, if both should become involved the situation would become acute. It appears that in mild conditions the fold only would be invaded, but it seems sure that if there were much swelling of the structure the fluid would almost certainly have to extend down over the esophageal surface of the cricoid and also invade the deeper tissues on the interior of the larynx. If this involved only one side there would still be breathing space, but if both were involved there would be asphyxia.

The findings seem to emphasize the need for careful watching in any case in which edema has developed or may develop, as the fluid may travel fast and far and when there is swelling of the upper structures one cannot see how rapidly the obstruction is developing below. One should always be prepared for emergency tracheotomy at the first signs of acute asphyxia.

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OF WHAT VALUE IS ROENTGEN THERAPY FOR SINUSITIS?

A RHINOLOGIC STUDY OF TWENTY-TWO CASES

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Rhinologists are frequently confronted today with the question of the value of roentgen therapy for sinusitis. Are they sufficiently informed of the effects and end results of this type of therapy to give an intelligent answer?

A review of the literature indicates that little has been written on this subject by rhinologists, either in America or abroad. With few exceptions it is discussed by radiologists alone. While this may seem logical, it is, on the contrary, impracticable. One cannot omit the rhinologic phase if the end result is to be properly evaluated.

Thost [1] first called attention to this form of therapy, in 1913. However, little interest was shown in the United States until 1923, when Osmond [2] reported a series of cases in which treatment was favorable. Heidenhain and Fried [3] followed this report in 1924. Beginning at this time many indifferent and conflicting reports appeared in foreign literature, but it was not until 1932, when Butler and Woolley [4] reported 100 cases of chronic sinusitis treated with promising results, that radiologists in America developed much interest. In their enthusiastic presentation at the meeting of the American Medical Association in 1934 Butler and Woolley [5] discussed the follow-up results of treatment in 450 cases, naming five classifications of sinusitis, with an aggregate report as follows: entire relief in 55 per cent of cases, definite improvement in 36 per cent and no improvement in 9 per cent. Their best

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Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society, Inc.

1. Thost, A.: Die Behandlung von Erkrankungen der oberen Luftwege und Ohren mit Roentgenstrahlen, Monatschr. f. Ohrenh. **48**:84-106, 1914.

2. Osmond, J. D.: Roentgen Therapy of Acute Infections of the Antrum and Frontal Sinus, Am. J. Roentgenol. **10**:374-377, 1923.

3. Heidenhain, L., and Fried, C.: Röntgenbestrahlung und Entzündung, Arch. f. klin. Chir. **133**:624-655, 1924.

4. Butler, F. E., and Woolley, I. M.: Roentgen Therapy in Chronic Sinusitis, West. J. Surg. **40**:379-383, 1932.

5. Butler, F. E., and Woolley, I. M.: Roentgen Therapy in Chronic Sinusitis, J. Radiology **28**:528-537, 1934.

results were obtained in cases of chronic sinusitis with hyperplastic membranes and their poorest results in cases of polypi. In contrast to other observers, they obtained some response from patients with an atrophic type. They stated also that in cases of chronic sinusitis with fibrotic membranes their results were variable, while in cases of postoperative sinusitis only clinical improvement appeared. Warren[6] reported 72 cases in which sinusitis was treated in 1935 with good results. He included all forms of sinusitis except atrophic. He classified his cases in three groups stating that virgin sinusitis of the hyperplastic type gave the best response. The results with the purulent type were less spectacular and those in cases of polypi or cysts were disappointing. Collectively, his results were as follows: marked improvement in 40 per cent of cases, moderate improvement in 25 per cent, temporary results in 20 per cent and no change in 15 per cent. He did not report any patient as cured. Hodges[7] preferred to treat patients that manifest thick membranes with granulations. He believed that acute infections with pus, here as in other parts of the body, should be drained. Rathbone[8] reported a large series of cases (72) of children only with the following conclusions: 57 per cent of the patients apparently cured, 28 per cent improved and 15 per cent not benefited. He stated that the ideal child to treat is one with diffuse lymphoid hyperplasia throughout the sinuses and throat, with a watery discharge. Soloman and Weill[9] were less enthusiastic, stating that their results seemed only of sufficient interest to justify calling their colleagues' attention to this new form of therapy. Koch[10] in an exceedingly lengthy article discussed many phases of the treatment. His series consisted of 22 cases in which the patient responded well and 28 cases of chronic sinusitis in which the patient did poorly; that is, only 11 of the 28 patients recovered. He defined recovery as meaning disappearance of pain and secretion. Whether the membrane returned to normal or not he did not know. Holfelder[10a] said that the results in his experience were uncertain, and he expressed opposition to irradiation of the sinuses. Spiesz and Vosz[10a]

6. Warren, E. D.: The Value of X-Ray Therapy in Chronic Sinusitis, Laryngoscope **45**:864-876, 1935.

7. Hodges, F. M.: Roentgen Therapy of Infections of the Nasal Accessory Sinuses, Am. J. Roentgenol. **39**:578-584, 1938.

8. Rathbone, R. R.: Roentgen Therapy of Chronic Sinusitis in Children, Am. J. Roentgenol. **38**:102-108, 1937.

9. Soloman, I., and Weill, G. A.: La roentgenthérapie dans le traitement des sinusites, Oto-rhino-laryng. internat. **16**:523-525, 1932.

10. Koch, J.: Klinische und experimentelle Erfahrungen über die Röntgenbestrahlung akuter und chronischer Nebenhöhlenerkrankungen, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **143**:385-405, 1937.

10a. Cited by Koch.[10]

also were opposed to this form of therapy. Champeil and Tillier [11] have expressed with emphasis the definite relief of pain afforded their patients, but they were uncertain about any curative effects. Kisch and Salmond [12] voiced a like report on the treatment of 7 patients.

A personal check-up in 22 cases of chronic sinusitis observed before and after roentgen therapy has caused me to question whether the results generally reported in radiologic literature are not more apparent than real. It seems that this could be determined only by including clinical studies by the rhinologist and microscopic studies by the pathologist. The conclusions drawn from the study of this small group mean little statistically, yet close clinical and microscopic observation in a few cases may be of more worth than the evaluation of subjective symptoms and roentgen evidence in a much larger series. Four patients in my group showed complete relief of symptoms. The clinical findings were entirely normal and the diagnostic films clear. These patients were considered, in a sense, well. Eight patients were symptomatically improved; that is, they manifested better nasal respiration and less secretion. Follow-up films indicated moderate to complete recession of the membranes, which could be interpreted as improvement in some cases and complete relief in others. However, none of the patients were entirely normal clinically. Irrigations of the antrums of 3 of the 8 patients showed purulent discharge. Ten patients thought that they were not helped symptomatically. Scout films did not show any appreciable change from the original roentgenograms. Clinical examinations showed little or no difference from the condition before roentgen treatment. Four of the 10 patients who did not show clinical or roentgen change in their condition after treatment were operated on. Each patient was subjected to a double Caldwell-Luc operation. The antrums in each case were found to contain hyperplastic infiltration and polypoid granulations filling the cavity nearly to its capacity and accompanied by a purulent discharge. Cultures showed streptococci. Observations by direct inspection of the antral contents during operation did not vary from those on similar infections in other cases, in which the operative condition had not been subjected to irradiation. Adhesions or unusual difficulties were not encountered in removing the contents from the cavities. Healing was uneventful and results satisfactory. In other words, nothing out of the ordinary was encountered in the operative technic, healing or end results in these antrums to indicate that irradiation had affected them in any way.

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11. Champeil and Tillier, R.: Radiothérapie dans les sinusites fronto-maxillaires, Bull. et mém. Soc. de radiol. méd. de France **19**:420-422, 1931.

12. Kisch, H., and Salmond, R. W. A.: Treatment of Post-Operative Pain in Chronic Sinusitis by X-Rays, J. Laryng. & Otol. **49**:464-465, 1934.

Under microscopic study, sections made in these cases did not show evidence of roentgen therapy, with the exception of that from a patient who was operated on six days after his treatment. This sec-

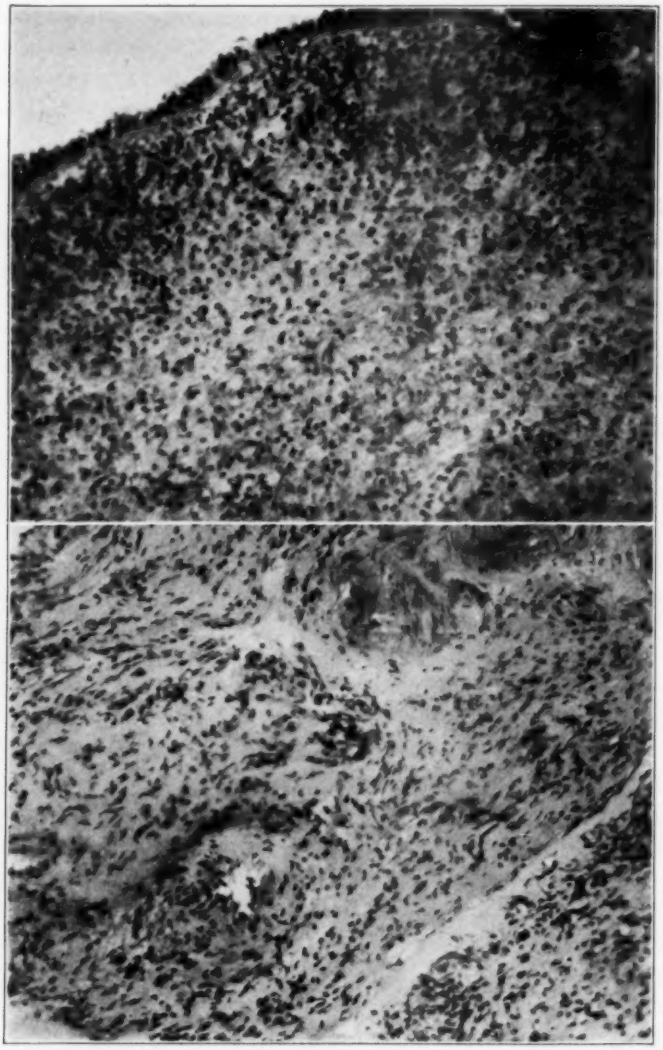

Fig. 1.—Photomicrographs of tissue removed from chronically inflamed antrums during Caldwell-Luc operations. Prior roentgen treatments have not left a demonstrable effect.

tion showed fewer lymphocytes than did the other slides. Otherwise, there was not any obvious difference. This is in keeping with the generally accepted opinion regarding the effect of roentgen treatment

in certain types of cases. It is possible that in the other cases a like change in the tissues was experienced, but regeneration of lymphocytes occurred during the longer interim between treatment and operation.

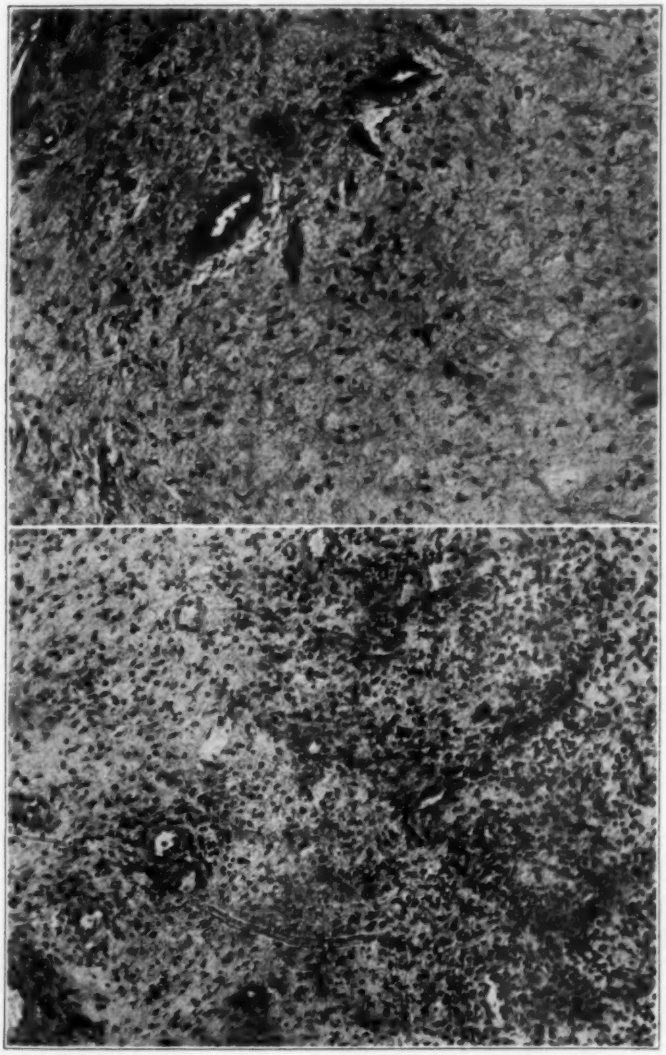

Fig. 2.—Photomicrographs made under the same conditions as those shown in figure 1, with the same results.

With this single exception all the sections showed infiltration of round cells and numerous fibroblasts with proliferation of connective tissue. Evidence of macrophages, arterial obliteration or necrotic spots was not

present. There were a few scattered areas of ciliated epithelium, but in the main this had been replaced by pathologic changes.

These 22 cases were observed before and after the radiologic treatments. My examinations consisted of the taking of histories, clinical inspection, investigation by shrinkage, suction and lavage and comparison of films taken before and after treatments. Rhinologists who interpret their own roentgenograms realize through other methods of examination how unreliable roentgen examination may be in analyzing disease of the ethmoid or the sphenoid sinus. Most of the roentgenologic literature describing films taken before and after treatments emphasizes in particular the antral changes, which are frequently marked if the sinusitis is hyperplastic. However, it is known that this is not sole proof, as parallel changes may occur spontaneously in many instances. Similarly, contrast shadows are not so easily demonstrated in the frontal sinuses, and I have never been able to note any appreciable difference in the roentgenograms of the ethmoid and sphenoid sinuses before and after treatment. Case reports that appear in the radiologic literature seem not to include any uniform rhinologic study whatsoever. If proper evaluation is to be made of this form of therapy the investigation should be shared by those versed in the clinical and microscopic aspects of this disease. Radiologic examinations alone are incapable of leading to such an evaluation. I make this statement in full recognition of the valuable part which roentgen examination plays in the diagnosis of sinusitis, as it has been my custom for the past fifteen years to make office routine of this procedure. In this connection Fenton [13] made the following statement:

> . . . reliance upon radiographic "diagnosis" must be confirmed by the clinician. It should be remembered that malignancy, syphilitic infiltration and long-standing fibrous changes may look just as opaque in a radiograph as do the edematous lining or the mucopurulent exudate of ordinary sinus diseases.

It is generally agreed by all radiologists and accepted by rhinologists that roentgen rays affect certain hyperplastic types of sinal membrane. In other types, there may be a temporary recession of lymphoid tissue with regenerative changes. Other membranes may present more established fibrosis, which resists irradiation from the outset. Without exception all roentgentherapeutists agree that their most favorable results are with sinusitis presenting marked infiltration with little air space and that thought to be subacute or of recent development. This is probably why young children, in general, are thought to be more responsive than adults. It is common knowledge that roentgen rays do not inhibit bacterial growth directly, yet this fact does not preclude

13. Fenton, R. A.: Recent Trends in Treatment of Sinus Disease, Northwest Med. **33**:90-95, 1934.

the rays from acting as an adjunct indirectly by promoting better drainage and ventilation in certain hypertrophic types. Fenton expressed the opinion that sinal membranes which present a preponderant lymphocytic infiltration may receive some benefit from this form of treatment. Larsell and Fenton [14] stated in another article that the therapeutic use of roentgen rays may produce some fibrosis following the destruction of round cells but that healing of suppurative changes in the submucosa cannot thus take place.

According to Larsell, as quoted by Butler and Woolley:[5]

> The effect of the x-ray treatment appears to be due primarily to an early destruction of the lymphocytes in the infected membranes. About 48 to 72 hours after treatment of membranes which had been infected for several weeks, there appears to be an increase in the number of macrophages. These are believed to come in response to substances released by the breaking down of the lymphocytes. These macrophages are seen to be laden with cellular débris and blood pigments. It is possible that they also engulf bacteria.
>
> The membrane becomes gradually reduced in thickness but retains numerous plasma cells, polymorphs, and some histocytes. After a week or more some fibrosis appears. Several weeks after irradiation, nodule-like masses of lymphocytes may be seen in some of the membranes, indicating a return of lymphocyte formation.
>
> There is no evidence of injury to the cilia, epithelium, or cellular elements other than the lymphocytes as the result of x-ray dosage. The fibrosis is considered a result of the inflammatory process, and the increased number of histocytes immediately following the infection.

Heine,[15] writing on the effects of irradiation on ciliated epithelium, corroborated these statements in effect. From the clinicians' point of view acutely inflamed sinuses should not be subjected to irradiation. This is especially true in cases in which ample drainage facilities may not be provided, on account of the acute swelling that may follow such a procedure.

A standardized technic does not appear to be used by radiologists as a whole for this form of therapy, judging from the literature. Many of the authors favor large infrequent doses, and others prefer light doses scattered over a longer period. The importance of proper technic in order to avoid undesirable effects on the eyes, the sense of smell and the hypophysis is stressed by all radiologists.

It is well recognized, with all the precautions considered, that it is impossible to irradiate all the sinuses without including the pituitary gland. Knowing that glandular structure is peculiarly sensitive to

14. Larsell, O., and Fenton, R. A.: Further Research on Experimental and Clinical Sinusitis, Arch. Otolaryng. **20**:782-789 (Dec.) 1934.

15. Heine, L. H.: Effects of Radiation upon Ciliated Epithelium, Ann. Otol., Rhin. & Laryng. **45**:60-74, 1936.

roentgen rays, one should proceed cautiously in applying this therapy to the young. It is my suggestion that animal experimention with similar technic should be thoroughly exploited before this form of therapy is accepted as harmless.

CONCLUSIONS AND SUMMARY

It seems that roentgen therapy for any form of sinusitis is in its earliest experimental stage.

Closer cooperation between the radiologist, the rhinologist and the microscopist must be obtained before determining the true effects of this therapy.

It is essential that the rhinologist make the final examination in order to avoid erroneous conclusions in many instances.

Twenty-two patients were examined roentgenologically and rhinologically before and after receiving therapy, with no definite evidence of uniform improvement of the infection in spite of roentgenologic changes.

With the exception of a single case, microscopic examination of the polypoid content of 8 antrums which had been subjected to roentgen therapy did not show any obvious difference from similar pathologic contents of other antrums which had not received like treatment.

Drs. William A. Shepherd and George Z. Williams interpreted the microscopic slides.

USE OF EXPANDING ESOPHAGOSCOPE FOR EXTRACTION OF FOREIGN BODIES

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KAUNAS, LITHUANIA

The extraction of a foreign body is often most difficult, and in some cases the usual instruments prove unequal to the task. This being so, the use of certain new instruments is a great help, among which is the expanding esophagoscope which I have designed.[1]

The great difficulty met in using some instruments is due to the tendency of the wall of the esophagus to contract and to press the ends of the tubes together. In designing my instrument, I aimed to remove this disadvantage.[2]

The expanding esophagoscope consists of a special extension mechanism, permitting adjustment of the grooved halves of the speculum in relation to each other as desired and helping to resist the considerable pressure of the esophagus, and various interchangeable grooved speculums differing in size and shape, viz., round, rectangular, square and oval.

In its closed position, thanks to its slenderness, the instrument can be easily introduced (fig. 1), after which it can be adjusted to the desired width and the distance between the halves of the speculum set as required. The mechanism provides for a great expansion between the halves of the speculum.

The uses to which the expanding esophagoscope can be put are various. My experience has shown that it is useful for the extraction of large foreign bodies. Once introduced, the esophagoscope can be expanded to the necessary width, and the foreign body can be seized and withdrawn without causing any wound in the wall of the esophagus.

Two cases are cited here as examples:

CASE 1.—A woman aged 46 when eating soup felt something lodge in her throat and was unable either to eat or to drink anything. Living far away in the country, where a physician was not available, she did not make an immediate attempt to secure medical aid, and it was only on the third day that she visited a physician in a neighboring town. From him she was sent to me, arriving on the fourth day.

1. Matis, E. I.: Der erste Schritt zur Konstruktion eines parallel spreizbaren Broncho-Oesophagoskopes, Monatschr. f. Ohrenh. **70**:929, 1936.

2. Matis, E. I.: Was wird mit der Konstruktion des spreizbaren Broncho-Oesophagoskopes bezweckt? Acta oto-laryng. **25**:61, 1937.

The patient was a stout woman with a short neck. She complained of pain in the side of her neck when it was touched. There was also some swelling at that point. She had a slight fever and was unable to swallow at all.

Operation.—Local anesthesia of the pharynx was induced with a 2 per cent solution of pantocaine hydrochloride. The patient was seated, in the position recommended by Killian.

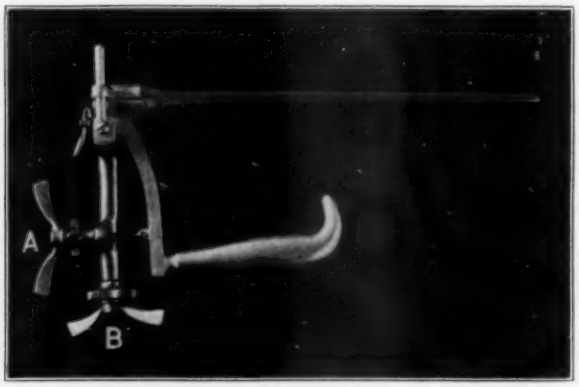

Fig. 1.—Expanding esophagoscope in closed position.

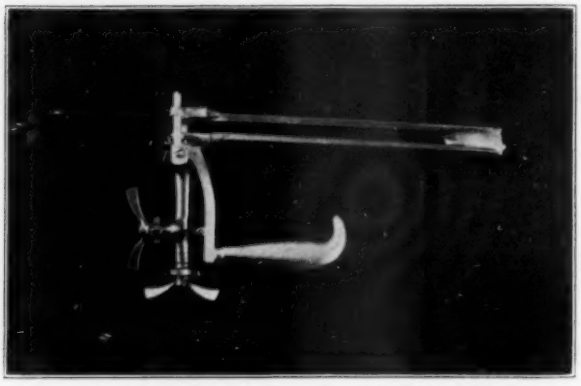

Fig. 2.—Extraction of a medium-sized foreign body.

The expanding esophagoscope with oval speculums was introduced into the upper part of the esophagus, and the foreign body was at once seen in the hypopharynx. It turned out to be a large piece of bone embedded in the swollen and inflamed mucosa. The difficult task of removing the bone without wounding the vulnerable mucosa was accomplished with the expanding esophagoscope. By carefully manipulating the instrument, which was gradually expanded and turned until it became possible to approach both the sharp ends of the bone, one of the ends was grasped and drawn into the tube with a pair of forceps. Withdrawing the instrument together with the piece of bone, further injury to the mucosa was avoided.

Postoperative Course.—Examination showed that the foreign body, which had been lodged in the hypopharynx for four days, had inflicted a serious wound there. A week later, in spite of this, the patient had completely recovered. The piece of bone removed was about 3.8 cm. long. It must be considered extraordinary that the patient recovered without any particular complications.

CASE 2.—A man aged 49 visited me and said that two days previously, when he was eating, something had become lodged in his throat. He complained of severe pain in the upper part of the thorax when swallowing. For two days he had taken only liquids, in small quantities, owing to the pain.

Operation.—With the area under local anesthesia, the expanding esophagoscope was easily introduced and the foreign body at once located. It turned out to be a long, thin piece of bone, the sharp end of which was embedded in the wall of the esophagus about 22 cm. from the front teeth. By carefully expanding the esophagoscope it was possible to grasp the free end of the bone, which also was

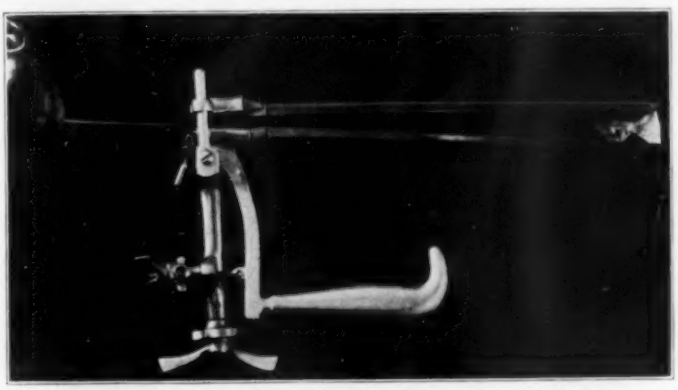

Fig. 3.—Extraction of a foreign body having sharp edges.

sharp, and to remove it without any further injury to the surrounding tissue. The patient recovered without complications.

My experience has confirmed the practical use of the expanding esophagoscope for the extraction of large foreign bodies from the esophagus. A particular advantage is the fact that the parts of the speculum can be adjusted to any position.

Another field in which the expanding esophagoscope proves useful is the extraction of small foreign bodies lodged in the upper parts of the esophagus or in the hypopharynx, which are often difficult to locate. The following case is an example of this:

CASE 3.—A woman 56 years old felt that some foreign body was lodged in the upper part of her throat, a feeling that continued for several days. She went to a hospital, where she was examined carefully, but with the aid of an esophagoscope nothing could be found. As the patient still continued to complain that there was something in her throat, she visited me, and I made an examination using the expanding esophagoscope on March 10, 1938. The introduction of the instrument was effected not without difficulty, and at first only some inflammation of the

mucosa was seen. However, when the esophagoscope was expanded gradually, a small piece of bone was detected in the inflamed tissue of the lateral wall of the hypopharynx, and this was removed without difficulty.

CASE 4.—A man aged 39, after eating fish felt that he had swallowed a bone. He at once visited me, but I was unable to find anything. As the patient still insisted that there was a bone in his throat, the expanding esophagoscope was introduced, but at first nothing out of the way was noticed. However, when the instrument was expanded, the end of a thin fish bone was seen in the region of the piriform sinus. A closer examination revealed that the greater part of the bone was embedded in the mucosa, and it was extracted without difficulty, the patient recovering without complications.

It is often difficult to find foreign bodies in the region of the piriform sinus, especially when they are small and may easily escape detection.

Von Eicken,[3] with his great experience in the extraction of foreign bodies, spoke of the difficulty of finding them in the piriform sinus and

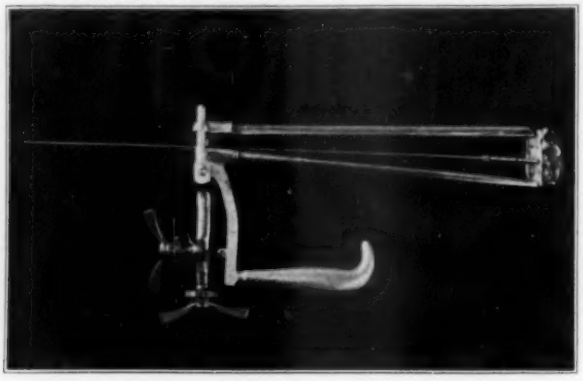

Fig. 4.—Extraction of a large foreign body.

said that if examination of the esophagus gives a negative result, a careful inspection of this region must be carried out. Because the region of the piriform sinus is wide and it is difficult to make a close examination with an ordinary esophagoscope, the expanding esophagoscope is of great assistance in such cases.

The expanding esophagoscope proves useful, too, for the extraction of sharp bodies, because it protects the mucosa of the esophageal wall from further injury. By expanding the tubes it is possible to grasp foreign bodies and draw them into the speculum, which itself protects the esophageal wall.

CASE 5.—A 29 year old man swallowed a bone when eating soup and later found it impossible to swallow at all. He complained of pain and came to me for treatment.

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3. von Eicken, C.: Ueber 3 bemerkenswerte Fremdkörper der Speiseröhre, Ztschr. f. Hals-, Nasen- u. Ohrenh. **4**:163, 1923.

Esophagoscopic examination revealed a large piece of bone embedded in the mouth of the esophagus. Closer examination showed it to have jagged edges. By expanding the tubes of the esophagoscope it was possible to seize one end of the bone with one pair of forceps and the other end with a second pair. Approaching the end of the esophagoscope to the bone, one could draw it into the tubes and in this way remove it completely without further injury to the tissue.

Generally speaking, the advantage of the expanding esophagoscope is that in its closed position it is easily introduced without inconvenience to the patient and that it can then be adjusted to the desired width and the distance between the parts of the speculum set as required.

In practice the expanding esophagoscope is used as follows:

The instrument is introduced in its closed position. Screw *A* (fig. 1) is then turned, opening the tubes at the ends. By moving screw *B* the two tubes are made parallel to each other.

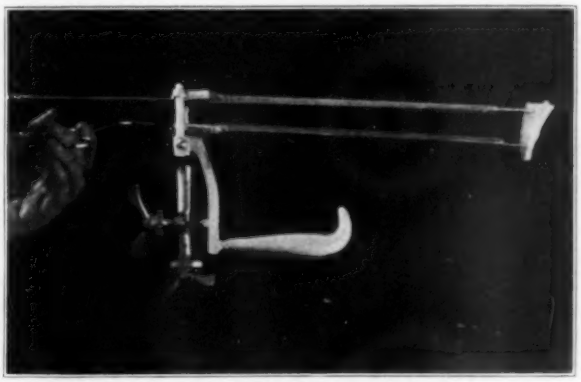

Fig. 5.—Extraction of a foreign body with two pairs of forceps

Various-shaped tubes can be adapted for certain purposes.

The oval tube is used for the extraction of large foreign bodies, while for the purpose of examining the hypopharynx the grooved tube is preferable.

I first used the expanding esophagoscope about ten years ago. At first all attempts to adapt existing instruments (those of Hill Brünings, Seiffert, Haslinger, Killian, Dufourmentel, Claoué and others) to my purpose failed, and it was necessary to construct an instrument on an entirely new principle. After numerous attempts, I succeeded in designing an instrument, and it was demonstrated before the Société de Broncho-Oesophagoscopie in Paris in 1935 [4] and 1936 [5] and before the

4. Matis, E. I.: Un nouvel œsophagoscope dilatable, Bronchoscop., œsophagoscop. et gastroscop., 1936, p. 14.

5. Matis, E. I.: Démonstration de quelques perfectionnements du broncho-œsophagoscope dilatable, Bronchoscop., œsophagoscop. et gastroscop., 1937, p. 11.

International Otolaryngologic Congress in 1936. In recent years the instrument has been improved. On the basis of experience gained in the use of the expanding esophagoscope, I consider that the instrument well serves the purposes mentioned in this paper and widens the possibility of extracting foreign bodies from the esophagus, especially those which are large, are embedded in the tissue, are sharp and with jagged edges or are difficult to find.

OSSEOUS LESIONS OF NOSE AND SINUSES

WITH SPECIAL REFERENCE TO HYPERTROPHIC CHANGES AND TUMOR FORMATIONS

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PHILADELPHIA

The bones of the nose and sinuses are not uncommonly subjected to hypertrophic changes. These changes are usually considered to be neoplastic and are ordinarily diagnosed and treated as osteoma. In the study of a group of cases that have come under my observation, I found that there is considerable confusion as to the exact meaning of the term "osteoma." To the pathologist it is a term under which he discusses many forms of overgrowth of bone. To the laryngologist it is a definite clinical entity. He considers it a tumor originating in the bones of the nose and sinuses, encroaching on the cavities, and giving rise to symptoms of deformity, displacement, obstruction and pressure.

Ewing [1] stated: "Circumscribed overgrowth of bone occurs under such a wide variety of conditions and the distinctions between inflammatory and neoplastic hyperplasia of the tissue are so often obscure that it has never been possible to exactly define the limits of osteoma." He also mentioned that Borst, who separated from the tumors all the bone-producing processes which are self limiting or clearly associated with trauma and inflammation, had little to say about true osteoma.

At the present time there is an extensive literature available on osteomas of the nasal cavity and paranasal sinuses. It is concerned chiefly with the gross and clinical aspects of the lesion. Case reports and reviews of the literature have been frequent in the past decade, so that the general characteristics from a clinical standpoint are well understood. In the majority of the case reports scant discussion has been given to the histopathologic observation and pathologic interpretation of the lesions, in an effort to establish their basic nature.

The interesting feature of the cases that have come under my observation has been that grossly or clinically they were distinguished as tumors but that microscopically it was often impossible to classify them as true neoplasms. The limits of osteoma have not been defined. The

Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society, May 1939.

1. Ewing, J.: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928.

distinction between bone formation of neoplastic origin, i. e., a true tumor, and processes following trauma, inflammation and disturbance of nutrition which result in bone formation is obscure. A number of writers agree that neoplastic qualities occur in many bony lesions in which trauma, inflammation or nutritional disturbances were originally concerned. The neoplasia is a secondary rather than a primary process.

Davies-Colley [2] classified osteoma under the focal forms of fibrocystic disease of bone, often called osteitis fibrosa. This is not to be confused with von Recklinghausen's disease, which is a generalized disorder of bone due to dysfunction of the parathyroids. He considered it part of a group of tumors comprising a wide range of growths, beginning at one end of the scale with a tumor composed of pure fibrous tissue, generally encapsulated and conforming with the accepted definition of fibroma, and reaching at the other end of the scale a tumor composed of dense bone—the compact osteoma. Between these extremes are intermediate forms illustrating every degree of proportionate admixture of the two substances, bone and fibrous tissue. In assigning a cause for their development he expressed the belief that trauma is sufficient. They are considered to be disordered reparative processes in response to injury, and the completeness of their departure from the normal reactions places them among the neoplasias.

The pathologic action of trauma on the bone as a cause of the development of osteitis fibrosa was considered by Lang.[3] He regarded osteitis fibrosa as a secondary process, dependent on circulatory disturbances the result of trauma. If one considers that many of the so-called osteomas are but variants in the osteitis fibrosa group, a similar origin for them must be thought of. From such a point of view one does not try to define or separate such lesions into neoplastic and hypertrophic but regards them as combinations of the two. From my study such a broad conception better fits many of these osteomatous lesions. They may be placed in this somewhat loosely defined group of fibrocystic lesions of bone and related to focal osteitis fibrosa, solitary bone cyst and the benign giant cell tumor. Geschickter and Copeland [4] considered solitary bone cyst and osteitis fibrosa as a variant of a lesion which begins as a giant cell tumor resulting from trauma. My investigation indicates that some of the osteomas of the bones of the nose and sinuses may be included in this group. The essential primary process is one of healing or repair with new bone formation, and the sequence of events would be: trauma—giant cell tumor—bone cyst—osteitis fibrosa—osteoma. I

2. Davies-Colley, R., in Discussion on Fibrocystic Disease of Bone, Proc. Roy. Soc. Med. **27**:973-983 (May) 1934.

3. Lang, F. J.: Osteitis Fibrosa, Am. J. Path. **8**:263-270 (May) 1932.

4. Geschickter, C. F., and Copeland, M. M.: Tumors of Bone, New York, American Journal of Cancer, 1931.

do not intend to infer that all osteomas are to be classified in such a way, as no doubt many are primarily true neoplasms and begin as such.

Such a thesis as to the etiologic nature of some of these osteomas may seem far afield to the laryngologist. However, it will be pertinent to compare some of the outstanding gross and microscopic characteristics of the lesions which fit in with this conception.

The age distribution is one of the outstanding clinical features of osteomas. They occur in early life, most often in youth up to the age of 30. Eckert-Moebius [5] reported 276 cases. The age was given in 163 and in 70 of these the osteomas occurred in the third decade. According to Armitage,[6] they occur in adolescence in 50 per cent of cases and before the age of 50 in 80 per cent. In the cases that I have studied the ages were: 28 (male), 21 (female), 19 (female), 14 (male), 16 (male), 21 (female). Geschickter and Copeland [7] gave a chart showing the age distribution of bone cysts and giant cell tumors in 400 cases. In 50 per cent these lesions occurred before the age of 31. I have plotted on this same chart the age grouping of osteomas in the 163 cases reported by Eckert-Moebius [5] (fig. 1). This similarity in age distribution does not prove a connection between the three types of lesion, but it gives a point in common which may be significant.

The incidence of trauma and its importance as a causative factor in cases of osteoma has been commented on by numerous writers (Gerber; [8] Culbert; [9] Garrettson; [10] Fetissof; [11] Carmody; [12] Fenton [13]). Of the cases which I have observed, there was a definite history of trauma in 2. Trauma is generally accepted as the important causative factor in the production of giant cell tumor, bone cyst and focal forms of osteitis fibrosa (Lang; [3] Geschickter and Copeland; [4] Lubarsch [14]).

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5. Eckert-Moebius, A., in Denker, A., and Kahler, O.: Handbuch der Hals-Nasen-Ohrenheilkunde, Berlin, Julius Springer, 1926, vol. 5, p. 118.

6. Armitage, G.: Osteoma of Frontal Sinus, Brit. J. Surg. **18**:565-580 (April) 1931.

7. Geschickter and Copeland,[4] p. 244, fig. 161.

8. Gerber, P. H.: Les ostéomes du sinus frontal, Arch. internat. de laryng. **23**:1-17, 1907.

9. Culbert, W. L.: Multiple Osteoma of the Nasal Accessory Sinuses: Report of a Case Complicated by Syphilis; Operation; Autopsy, New York State J. Med. **18**:465-472 (Dec.) 1918.

10. Garrettson, W. T.: Osteoma of Frontal, Maxillary and Sphenoid Sinuses, with Report of Cases, Arch. Otolaryng. **5**:135-142 (Feb.) 1927.

11. Fetissof, A. G.: Pathogenesis of Osteomas in Nasal Accessory Sinuses, Ann. Otol., Rhin. & Laryng. **38**:404-412, 1927.

12. Carmody, T. E.: Osteoma of Nasal Accessory Sinuses, Ann. Otol., Rhin. & Laryng. **44**:626-643 (Sept.) 1935.

13. Fenton, R. A.: Osteoma Causing Nasociliary Neuralgia, Ann. Otol., Rhin. & Laryng. **42**:911-914 (Sept.) 1933.

14. Lubarsch: Die Bedeutung des Traumas für Entstehung und Wachstum krankhafter Gewächse, Med. Klin. **8**:1651-1654, 1912.

In spite of the great frequency of trauma in childhood, giant cell tumor, solitary bone cysts, osteitis fibrosa and osteoma occur in few children. Some other primary factor may play an important part. This may be related to nutritional or metabolic derangements, which are prone to affect the period of growth and development.

The site of origin is another interesting point of comparison between giant cell tumor of the head and osteoma. Geschickter and Copeland [4]

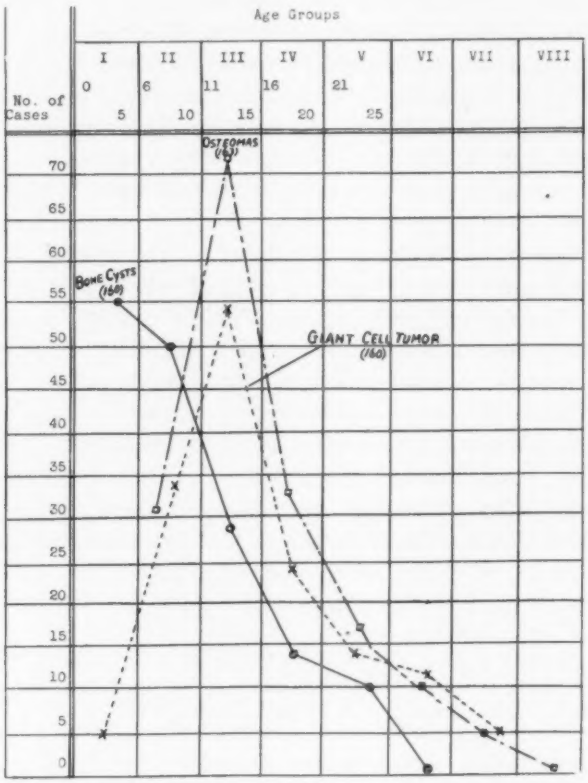

Fig. 1.—Age distribution of large numbers of bone cysts, osteomas and giant cell tumors.

studied this carefully in 22 cases of giant cell tumor occurring in the head from the records of the surgical pathologic laboratory of the Johns Hopkins Hospital. They found definite support for the belief that the origin of the pathologic process was at the sites of bone formed from cartilage.

The accompanying table, from Jordan and Kindred,[15] summarizes the essential points in the histogenesis of the chondrocranium. The same information is given diagrammatically in figure 2.

15. Jordan, H. E., and Kindred, J. E.: A Textbook of Embryology, New York, D. Appleton and Company, 1926.

If one studies the site of origin as observed in the large number of reported cases of osteoma, one finds that the most frequent sites coincide in locality with the centers of intracartilaginous ossification as outlined in the table and figure 2.

In Boenninghaus' [16] collection of 203 cases, the site was classed as frontal in 75 and as ethmoid in 36. Eckert-Moebius [5] records 276 cases,

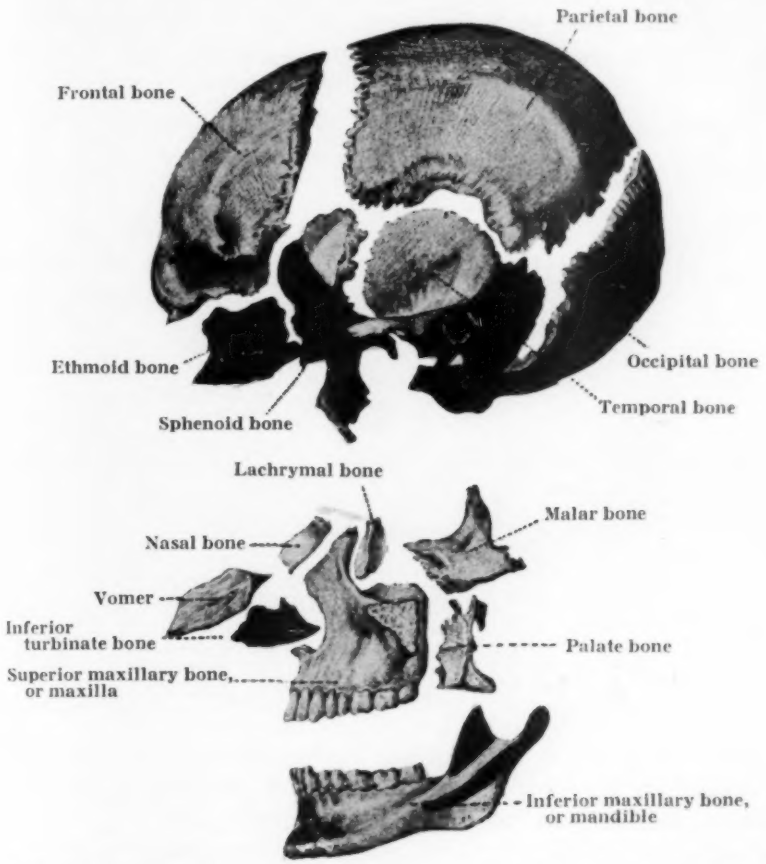

Fig. 2 (after Toldt).—The areas in black show the portions of the adult skull formed from cartilage. See the table.

in which the site of origin was as follows: extranasal, 20 cases; intranasal, 34 cases; frontal sinus, 113 cases; ethmoid cells, 56 cases; maxillary sinus, 13 cases; sphenoid sinus, 7 cases. Tillmanns [17] concluded

16. Boenninghaus, G., in Katz, L.; Preysing, H., and Blumenfeld, F.: Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege, Würzburg, Curt Kabitzsch, 1913, vol. 3, p. 222.

17. Tillmanns, H.: Ueber todte Osteome der Nasen- und Stirnhöhlen, Arch. f. klin. Chir. **32**:677-690, 1885.

that the point of predilection was the ethmoid labyrinth and that the greater proportion of frontal osteomas really arose in the ethmoid cells. Many other investigators have concurred in this opinion. The common site of origin is thought to be the suture between the frontal and the ethmoid bones (Bornhaupt;[18] Arnold;[19] Knapp[20]). In my cases the site of origin was the maxilla in 1 case, the ethmoid labyrinth in 3 cases and the floor of the frontal sinus, probably the ethmoid level, in 1 case. One case of benign giant cell tumor was included in the study for comparison. The tumor was located in the right upper jaw.

Relationships of Centers of Ossification of the Chondrocranium (from Jordan and Kindred[15])

Chondrocranial Regions	Centers of Ossification	Parts of Adult Skull
Occipital	Basioccipital	Basilar process of occipital bone
	Exoccipitals	Occipital condyles
	Supraoccipital	Squamous portion of occipital bone below the superior nuchal line
Sphenoid	Basisphenoid	Body of sphenoid bone
	Presphenoid	Body of sphenoid bone
	Lingulae	
	Alae magnae	Greater part of alae magnae
	Alae parvae	Alae parvae
Periotic capsule	Petrous primordium	Petrous portion, Mastoid portion } of temporal bone
Ethmoid	Nasal septum (mesethmoid)	Lamina perpendicularis, Crista galli, Nasal septum (cartilage)
	Paranasals (ectethmoids)	Lateral masses of ethmoid bone, Superior conchae, Middle conchae
	Cribriform plates	Cribriform plates
	Inferior conchae	Inferior conchae
	Sphenoidal conchae	Sphenoidal conchae

Thus one may see, in comparing the influence of age, trauma and site of origin in these lesions (solitary bone cyst, benign giant cell tumor, osteitis fibrosa, osteoma) that there is a suggestive similarity.

Finally, an analysis of the histologic observations on a group of osteomas indicates that in many of the histologic features of some of them there is a resemblance to this fibrocystic group of lesions. This is illustrated in an examination of the histologic features of the cases reported here.

18. Bornhaupt, T.: Ein Fall von linksseitigem Stirnhöhlen-Osteom, nebst Bemerkungen über die in den Nebenhöhlen der Nase sich entwickelnden Osteome, Arch. f. klin. Chir. **26**:589-644, 1881.

19. Arnold, J.: Zwei Osteome der Stirnhöhlen, Virchows Arch. f. path. Anat. **57**:145-163, 1873.

20. Knapp, J. H.: Beschreibung eines Falles von elfenbeinerner Orbitalenostose, Arch. f. Ophth. (pt. 1) **8**:239, 1861.

REPORT OF CASES

CASE 1.—R. T., a white man aged 28, was first seen on July 7, 1925, complaining of complete obstruction of the right side of the nose. The family and the past medical history were not pertinent.

The nasal obstruction was of three or four months' duration. It was partial at first but gradually progressed until it was complete. There was no history of injury, epistaxis, nasal discharge, pain, headache or any discomfort aside from that due to the obstruction. There were no symptoms referable to the ears or eyes.

The general physical examination gave negative results. The urine was normal, and the Wassermann tests of the blood were negative.

Examination of the nose revealed a reddish granular-looking mass completely filling the right nasal chamber. A probe showed this to be a very hard substance, firmly fixed and unyielding, superficially covered anteriorly by dark reddish tissue, which bled freely when touched. When this was removed, a smooth grayish

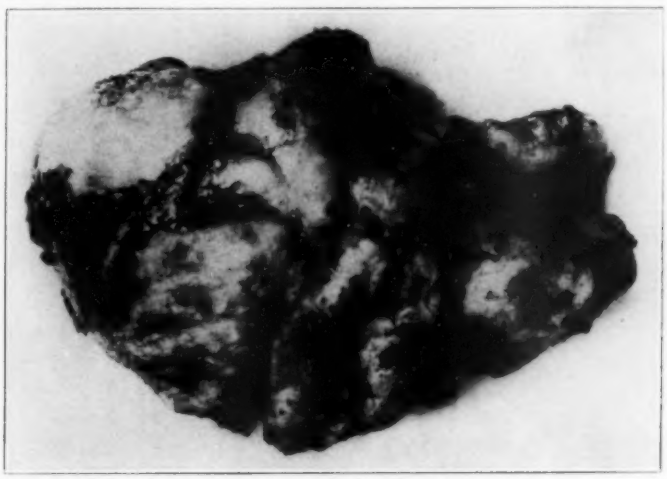

Fig. 3 (case 1).—Photograph of the entire growth removed from the right nasal chamber. It measured 6 by 4.5 by 3 cm. and weighed 65 Gm.

surface came to light which had the appearance and consistency of bone. Palpation in the nasopharynx showed that the mass extended through the choana and was of similar hardness posteriorly. It completely filled the right nasal chamber. The left side of the nose appeared normal. The septum bulged somewhat into the left nasal chamber, owing to pressure from the mass on the right side. The report of the roentgen examination was as follows:

"There is a large bony growth, ovoid, occupying the entire right nasal chamber and spreading into the posterior nasal space on the right side. The nasal wall of the antrum has been pushed outward and the roof of the palate downward by pressure. Its point of origin is uncertain, but we believe it to be somewhere in the ethmoidal spaces. It is of even density and rather well circumscribed on all its borders."

The problem of operative removal was a difficult one. The mass was too large and too firmly fixed to be dislodged through the nares or the choana. It was like ivory in hardness and could not be broken up even with a dental drill. With the

patient under ether anesthesia, an incision was made beneath the upper lip and the nose retracted upward (sublabial rhinotomy, or Rouge's operation). The cartilaginous septum was divided near the floor of the nose and pushed to the left. The lateral nasal wall had been obliterated by pressure from the mass, and it was necessary to open into the right antrum in order to get around it. A portion of the superior alveolar margin of the maxilla was removed to enlarge the pyriform aperture and allow passage of the mass. It was finally delivered by the exertion of great force.

Fig. 4 (case 1).—Photomicrograph (× 200) showing the histologic characteristics of a compact osteoma.

The tumor was found to be a very hard, eburnated bony growth. Its surface was light gray and relatively smooth. It was somewhat nodular. It measured 6 by 4.5 by 3 cm. and weighed 65 Gm. The entire growth appeared to be limited by a very thin fibrous capsule. Its point of attachment could not be definitely determined. However, it is thought there was a small pedicle attaching it to some point in the right ethmoid area which was broken away by the vigorous rocking and prying necessary in the removal of the growth. The microscopic examination, by Dr. Baxter L. Crawford, was reported as follows:

"Sections from the mass are composed of rather dense, compact bone, in which there are a number of vessels, varying in size. There is little connective tissue in the sections. The growth seems to be of uniform consistency and structure. Diagnosis: osteoma, compact type."

The interesting features of this tumor were: its large size, filling the right nasal chamber; its marked density throughout, classifying it with the hard variety of osteoma (ossea eburneum), and the absence of symptoms. Nasal stuffiness was the only complaint. The growth had the features of a true neoplasm, i. e., a spontaneous, noninflammatory origin, a progressive course, a circumscribed form. The site of origin was apparently the ethmoid labyrinth.

Osteoma is much more rarely seen in the nasal cavities than in the accessory sinuses. This has been emphasized by Ernst, Lubarsch [14] and others who have collected cases. Among approximately 92 references to the subject of osteomas of the nose and sinuses listed in the *Quarterly Cumulative Index Medicus* since 1918 there are only 6 references to osteoma of the nasal cavity. Guthrie [21] and Goodyear [22] each reported a case of osteoma arising in the nasal septum and projecting into the nasal fossa.

Case 2.—R. B., a white girl aged 16, was first seen on April 21, 1926, complaining of disturbance of vision and bulging of the left eye. This had been present about two years, gradually becoming more marked. There was no diplopia and no pain. There was no history of injury.

The family history was not contributory.

At 6 years of age she had pneumonia complicated by a renal disturbance with edema of the face, hands and feet.

Physical examination showed rather marked bulging of the left eye due to a bony mass in the medial part of the orbit, which displaced the eyeball forward, downward and outward. There was no disturbance of the eyegrounds or media of the eye. The right eye was normal. The rest of the physical findings were unimportant. The nasal chambers were clear and unobstructed.

Roentgen examination showed a mass the density of bone, well circumscribed, with origin from the ethmoidal sinus, where there appeared to be some intracellular destruction. It had invaded the orbit and pushed the supraorbital plate upward.

On May 5, with the patient under nitrogen monoxide-ether anesthesia, an external incision was made along the lateral wall of the nose upward and out along the line of the eyebrow, and the lower part of the frontal sinus and the inner upper part of the orbit were exposed as in a radical operation on the frontal sinus. The bony growth was exposed, extending laterally from the ethmoid region and invading the orbit. It was about the size of a guinea hen's egg. It was white and almost as hard as ivory in consistency. It was removed in two pieces. The medial half attached to the ethmoid was freed with hammer and chisel. The left frontal sinus was not involved by the growth. The left nasal chamber was not entered.

21. Guthrie, T.: A Case of Osteoma of the Nasal Septum, J. Laryng. & Otol. **45**:189-191 (March) 1930.

22. Goodyear, H. M.: Osteoma of Frontal Sinus Extending into the Orbit and the Anterior Cerebral Fossa, Laryngoscope **35**:751-753 (Oct.) 1925.

Dr. Crawford reported on the pathologic examination of the lesion as follows: "The specimen consists of two irregular pieces of bone, one measuring 5 by 4 by 3 cm., the other 3 by 2 by 1 cm. They are nodular, covered by gray tissue and on section are very dense, hard and gray. Histologically, the masses are composed of very dense bony tissue, at the periphery of which there is little fibrous tissue,

Fig. 5 (case 2).—Photomicrograph under very low power (×7) showing the structure of a compact osteoma. Very dense bone is found at the periphery, with more fibrous tissue at the base of the attachment.

but a number of small irregular-shaped vessels. Near the tumor's base of attachment there is more fibrous tissue. Diagnosis: osteoma of the ethmoid, compact type."

From the clinical and pathologic study of this tumor it appears to be a true neoplasm, i. e., a true osteoma.

A number of cases of osteoma of the orbit have been described. Knapp [20] reported 4 cases of osteoma of the orbit, in each of which the point of origin was a paranasal sinus; these cases he found in a series of 56,000 cases. He believed that the most frequent site of origin was the

Fig. 6 (case 2).—Photomicrograph (× 100) showing the histologic structure of a compact osteoma similar to that in case 1.

floor of the frontal sinus. Andrews [23] compiled 8 cases from 439,000 cases of ocular disease. Bornhaupt [18] compiled 23 cases in which the growth originated in the bones of the frontal sinus and 26 other cases of osteoma of the orbit in which the growth originated in the bones of the

23. Andrews, J. A.: Successful Removal of Two Osteomata of the Orbit: One Originating in the Frontal, the Other in the Ethmoidal Cells with a History of Osteomata of the Neighboring Pneumatic Cavities of the Orbit, M. Rec. **32**:261-274 (Sept. 3) 1887.

ethmoid sinus. The common site of origin for a bony growth of the orbit is the upper inner segment. Ewing [1] stated that such osteomas not infrequently appear as congenital tumors in young girls. Virchow [24] concluded that they arise as enostoses of the orbital wall. He described 4 osteomas, in some of which cysts were found, lined by ciliated epithelium. Such a possibility must be thought of in this case, the growth remaining latent for some time and then being stimulated to active growth by some unknown exciting factor during the rapid period of bony growth and development characteristic of this period of life.

There is no element in the gross or miscroscopic aspects of these 2 tumors to indicate that they were a part of any other pathologic process than a true neoplasm.

Fig. 7 (case 3).—Photograph of the patient showing swelling of the left side of the nose and inner canthus of the left eye, pushing the eyeball laterally.

Case 3.—F. N., a white boy aged 14, was first seen on May 3, 1934, complaining of swelling of the left side of the nose and inner canthus of the eye, pushing the eyeball laterally. This was first noticed three years previously, following a blow in this area in August 1931. The swelling was directly related to the trauma.

The family history was not remarkable.

The past medical history was free of any serious illness or anything that could be related to the present complaint except for the history of trauma at the site of the growth. The patient thought that the swelling had not increased in size for the past few years.

24. Virchow, R.: Die krankhaften Geschwülste, Berlin, A. Hirschwald, 1864-1865, vol. 2.

Physical examination revealed a pale, undernourished youth with no systemic disease aside from some secondary anemia. The hemoglobin content was 70 per cent; the red blood cell count was 4,700,000. The Wassermann and Kahn tests of the blood were negative. The blood phosphorus and calcium were within normal limits.

The right eye was normal. The left eye was pushed to the left, and the vision was blurred as in case 2. At the inner angle of the eye a hard bonelike mass was palpable. The overlying skin was freely movable and appeared normal. It was sensitive to pressure. The mass appeared to spring from the bone of the left ethmoid sinus and projected toward the orbit.

The nasal chambers were not remarkable and were free of obstruction or evidence of inflammation. The left middle turbinate appeared prominent and somewhat enlarged.

Fig. 8 (case 3).—Photograph of the patient after operation, showing the return of the left eye to approximately its normal position.

The roentgenologist's report was as follows: "There is a circumscribed mass of increased density about the size of a half dollar, which seems to arise in the left ethmoid area. It extends lateral to the internal wall of the orbit and fairly well posterior. It does not seem to have destroyed the wall of the orbit, however. I get the impression that it is an osteoma. The sinuses are fairly well developed and well aerated."

The growth was removed May 11, 1934, with the patient under gas-ether anesthesia. It was exposed by means of an ethmofrontal incision as in an external approach to the ethmoid and frontal sinuses. It was sharply demarcated from the surrounding bone; it extended medially to the nasal septum and upward to the floor of the frontal sinus, and laterally it distended the medial side of the orbital plate, which was atrophied by pressure from the growth. The orbit was not invaded. The mass seemed to be attached to, and to spring from, the ethmoid region. It was irregular on its surface and about 1 inch (2.5 cm.) in diameter.

The mass was separated from surrounding tissue but was fragmented in the attempt to remove it in one piece. It had quite a hard surface or outer shell, which was easily broken. The inner part was rather spongy or cancellous. It was very much like breaking through a hard surface into a cystic cavity made up of spicules of bone and soft tissue. An opening was made into the left nasal cavity and the area packed with iodoform gauze from below and closed externally. The recovery was uneventful.

The histopathologic examination, by Dr. Baxter L. Crawford, was reported as follows: "The specimen consists of small pieces of soft bony tissue. The largest measures 1.5 cm. in its greatest dimension. Some portions of the bone seem to be shell-like in consistency. Examination of sections from the specimen reveals that it is composed of rather cellular bony tissue in which there is much

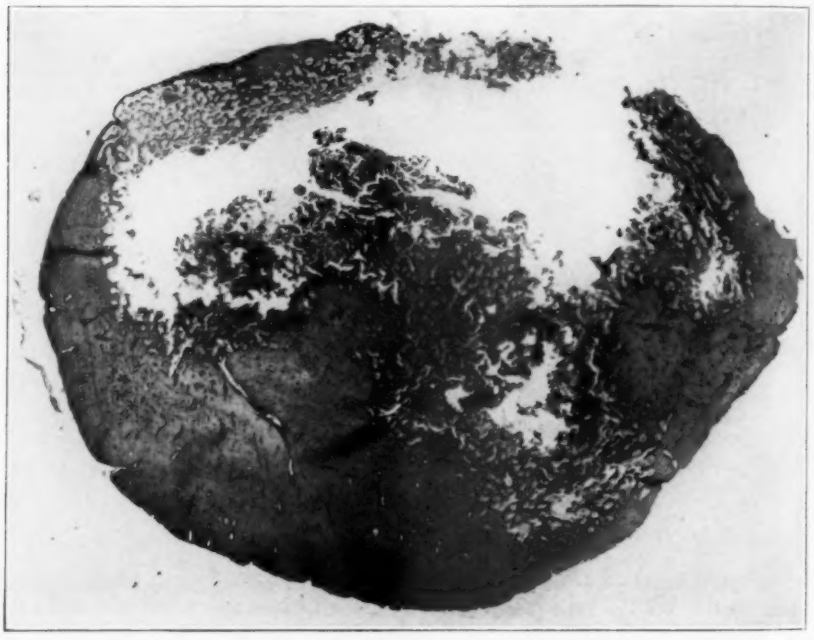

Fig. 9 (case 3).—Photomicrograph under very low power (×7) showing the structure of an osteomatous growth from the left ethmoid area. There is a hard outer shell of compact bone. The central spongy area of cellular tissue is made up of bone and connective tissue, in which, near the center, there is a cystlike area.

fibrous tissue. In some areas at the margin the bone is quite dense. Throughout the greater portion there are spicules of bone in which there is considerable cellular fibrous tissue. About the center of the larger piece there seems to be an area of degeneration or a small cyst."

From the microscopic picture one would be unable to distinguish sections of this lesion from those of osteitis fibrosa. A study of the photomicrograph illustrates the structure composed of bone and connec-

tive tissue. The large cells at the margin of the bone are considered to be osteoclasts, some of which are multinucleated. This suggests absorption of bone as well as bone formation and might easily be representative of a reparative or healing process following an earlier bone destroying stage in the pathologic process.

From the gross and clinical characteristics this could properly be classed and treated as osteoma. However, with a definite history of

Fig. 10 (case 3).—Photomicrograph (× 100) to illustrate the structural composition of the lesion, which is made up of bone and connective tissue. The large cells at the margin of the bone are considered to be osteoclasts, some of which are multinucleated, suggesting absorption of bone as well as bone formation. The histologic structure is similar to that of osteitis fibrosa.

trauma and the resemblance histologically to a healing reaction termed osteitis fibrosa, there is considerable doubt as to whether it should be considered primarily as a true neoplasm.

Case 4.—E. D. R., a white boy aged 16, was first seen on Aug. 13, 1931, with marked swelling, redness and tenderness over the left frontal sinus. The left eye

was closed by the swelling and edema of the surrounding structures. There were no nasal symptoms, such as obstruction or discharge. It appeared at first that this was acute frontal sinusitis with involvement of the soft tissue. The roentgenologist gave the following report: "There is an osteoma in the inner canthus of the left eye which involves the supraorbital ridge of the left frontal sinus. It is irregular in outline and no doubt has a rather broad attachment."

The boy's history revealed that a year and a half prior to this he struck his head at the root of the nose, smashing the septum and nasal bones and leaving a lump on the nose extending down to the inner canthus of the left eye. It

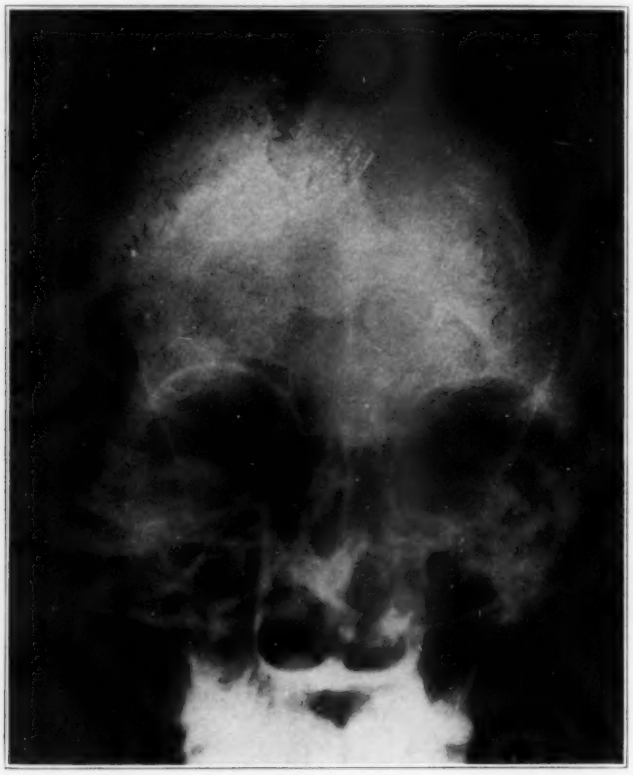

Fig. 11 (case 4).—Roentgen film showing the left frontal sinus completely filled with the tumor mass, which extends also into the right frontal sinus.

gradually increased in size, and in the summer of 1930 he first noticed some swelling of the forehead. The lump was gradually encroaching on his left eye. About a month prior to coming to the clinic he was struck heavily at the site of the growth during a fist fight. The acute symptoms of cellulitis with redness, swelling and tenderness followed.

The family history was unimportant.

Examination showed the left eyelids closed by the swelling and edema and marked tenderness with fluctuation over the swelling above the eye. The nasal chambers were clear, and there was no evidence of sinus infection.

An incision was made beneath the left brow and a considerable quantity of pus drained out. The cellulitis rapidly subsided, and the hard swelling of the tumor mass was readily palpated at the inner upper wall of the left orbit and over the inner third of the left frontal bone.

A second roentgen study was made after the acute inflammation had subsided and was reported as follows: "There is evidently a lesion involving the left frontal sinus in which there is some dense mass, the density being almost that of bone. It apparently is accompanied by thickening of the orbital wall and seems to project into the orbit. I should think the lesion is probably in the nature of an osteoma and probably a benign growth.

"The direct posteroanterior films show that the left frontal sinus is completely filled with the tumor mass and I believe that this mass is extending also into

Fig. 12 (case 4).—Roentgen film taken after operation, showing the amount of bone removed from the frontal area.

the right frontal sinus as well as into the left orbit. From the density of it I am reasonably certain that it is composed largely of bone tissue and that it has probably originated in the floor of the left frontal sinus."

The first operation to remove the growth was done in March 1932. It was exposed by an incision made through the eyebrow and around the lateral wall of the nose as for a radical operation on the frontal sinus. A large part of the growth was removed from the left frontal sinus, including the extension into the orbit. However, it was not completely removed. The swelling returned in the left frontal area and was accompanied by pain. It increased slowly but gradually, and a second operation was performed July 24, 1934. At this time there was resection of the frontal area, including both frontal sinuses and the inner and outer table of the skull.

A histologic description of the sections from the growth by Dr. Baxter L. Crawford follows: "The specimen removed in March 1932 is composed of large, irregular-shaped bone trabeculae separated by connective tissue of loose texture in which are numerous blood vessels. There seem to be small hemorrhages in the connective tissue, but no definite necrosis or cyst formation is observed.

"The specimen of tumor finally removed by resection of the frontal area two years later is composed of bone and connective tissue. The structure of the tissue varies considerably in different areas. Some parts are composed largely of rather dense bony tissue, in which there are a few haversian canals, and the tissue is rather dense, with few cells and considerable homogeneous staining intercellular substance. In the other places the fibrous tissue predominates. It is cellular and loose in texture and contains many blood vessels. Throughout the fibrous tissue there are many various-sized spicules of bone. The fibrous tissue is much more cellular and vascular in some areas than in others, but definite evidence of inflammatory reaction is not observed. In some of these areas the bone is evidently being absorbed, as there are numerous osteoclasts present, many of which are multinucleated. In the connective tissue there are numerous blood vessels and also larger spaces filled with blood, and in some instances, hemorrhage in the tissue. Attached to one of the pieces is a bit of mucosa composed of columnar epithelial cells. There is nothing noted in the histologic structure to indicate a definite neoplasm. The picture resembles that of osteitis fibrosa."

The blood calcium and phosphorus were within normal limits.

Some interesting features of this case are: the definite history of injury followed by evidence of the growth; the comparatively rapid growth following the incomplete removal; the similarity of the microscopic picture to that of osteitis fibrosa suggesting that factors other than a primary tumor growth influence lesions of this type.

Case 5.—M. M., a white girl aged 19, was first seen on May 8, 1929, complaining of painless swelling of her right cheek bone of about a year's duration. She had no nasal symptoms. She had received roentgen treatment at another hospital over a period of six months. No change was noted in the swelling or enlargement of the right cheek bone. Examination revealed a hard swelling of the right maxillary region from the alveolar margin to the orbit. It was not tender, and there was no apparent involvement of the soft tissues. Two upper right premolar teeth were removed along with some bone.

The histologic report on sections from the tissue removed was as follows: "The tissue is composed of cellular bone, in which there are areas of extensive fibrous tissue. In the fibrous tissue comparatively few blood vessels are observed. A few small fragments are composed almost entirely of very dense fibrous tissue. A number of sections were cut and examined, but there was no evidence of rapid growth or irregularity of the cells to indicate malignancy. The histologic diagnosis was fibroosteoma."

After this surgical intervention no change occurred until May 1934, when it was noted that the cheek was more prominent. Four months later, about September, she began having shooting pains in her right cheek, and the mass had become considerably larger. She was again admitted, October 1, five and a half years after the first admission.

Examination showed the right maxilla to be very prominent, the swelling extending to and elevating the right nasal bone. The upper right teeth and

Fig. 13 (case 5).—Photograph of the gross specimen, the right superior maxilla, removed at operation. Note the marked thickening of the entire bone and the nodular surface.

Fig. 14 (case 5).—Roentgen film showing the appearance after the removal of the right maxilla.

the entire right side of the palate had been pushed downward to a lower level than the left side. The vessels in the mucous membrane of the gums and palate were prominent. There was a denture at the site of the operation performed five and one-half years ago. There was no fistula or discharge and very little scarring. There were no symptoms referable to the nose or throat, and the general physical examination did not show anything remarkable. Determinations of blood components were: sugar, 86 mg.; calcium, 10.48 mg.; phosphorus, 5.42 mg.

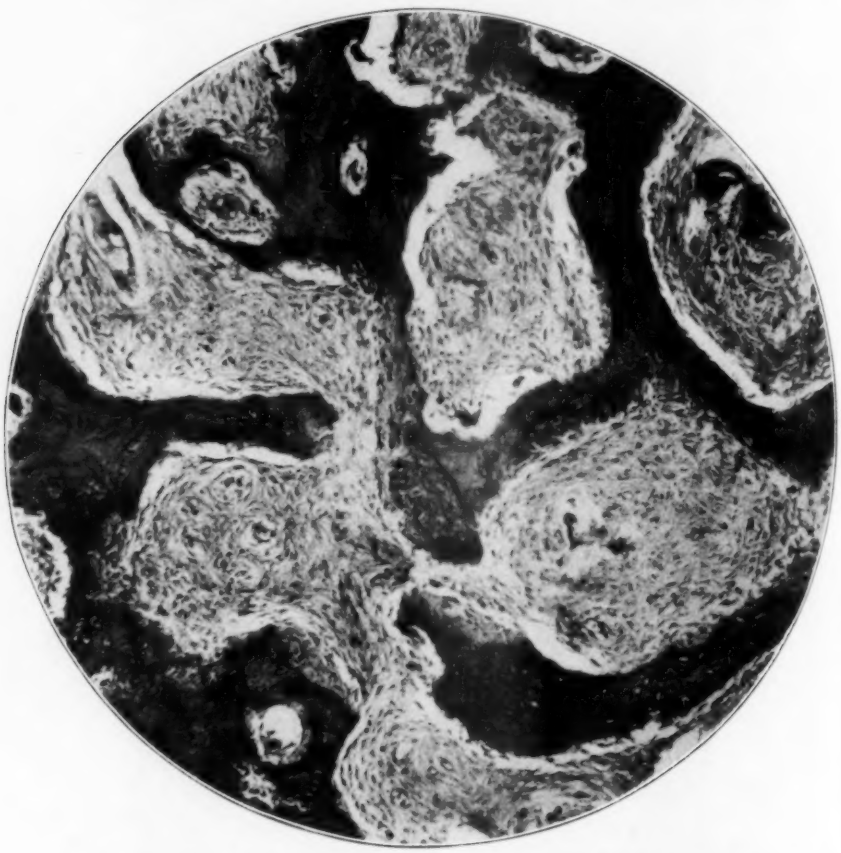

Fig. 15 (case 5).—Photomicrograph (× 200) of sections from the superior maxilla showing a structure composed of bone and cellular connective tissue similar to that seen in osteitis fibrosa.

She was operated on, October 2, under anesthesia induced by avertin with amylene hydrate, supplemented with ether. The anterior part of the maxilla, including most of the hard palate and remaining right upper teeth, was removed in one mass. This included the entire growth.

The report of the microscopic examination by Dr. Baxter L. Crawford follows: "Sections from the superior maxilla are composed of bone trabeculae, which vary in size and shape, and are scattered throughout connective tissue. The tissue is

vascular, but the arrangement of normal haversian systems is lacking. The connective tissue is quite abundant in areas and has a myxomatous appearance. No evidence of inflammatory reaction is observed. There are numerous small hemorrhages with necrosis and small cyst formations in the connective tissue. The histologic structure of sections from various parts of the lesion is essentially the same, with variation only in the proportion of bone tissue and connective tissue.

"The structure of this lesion is similar to the changes in the bone observed in osteitis fibrosa, but because of the nodular formation and the encroachment on

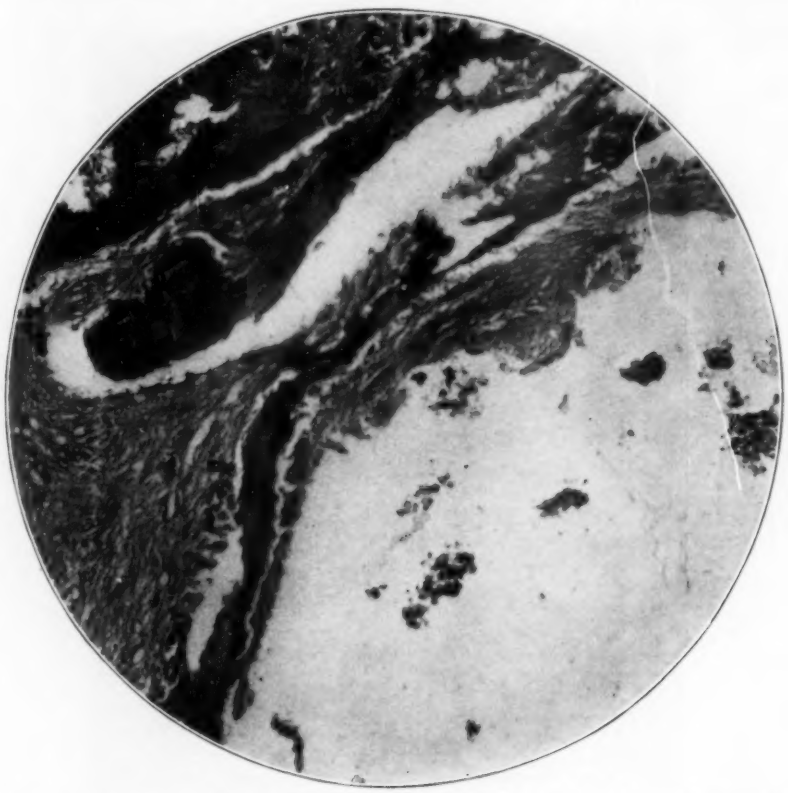

Fig. 16 (case 5).—Photomicrograph (× 100) of a section from the superior maxilla showing an area composed of fibrous tissue and bone, with the formation of a small cavity or cyst.

the sinuses it is classed as a neoplasm. Diagnosis: osteoma of the superior maxilla, porous type."

Case 6.—C. P., a white woman aged 21, was first seen on May 1, 1926, complaining of headache and of pain and enlargement of the right cheek. Her discomfort began six years previously, at the age of 15 years, with headache, then pain over the right cheek and gradual enlargement of the right cheek bone. There was no history of injury.

Physical examination showed apparent asymmetry of the face due to prominence of the right maxilla. The right alveolar ridge was enlarged and firm. The nose and throat were not remarkable. There was no evidence of sinus infection.

A piece of the enlarged right maxilla was removed for biopsy, the report on which, by Dr. Baxter L. Crawford was as follows: "The specimen consists of a number of bony fragments of tissue, the larger piece measuring 2 by 1 by 2.5 cm. While all of the tissue is bony, it is of spongy consistency.

"Microscopic examination shows the tissue composed of rather large irregular bone trabeculae scattered through connective tissue of loose texture, which con-

Fig. 17 (case 6).—Roentgen film showing increased density from the presence of a benign giant cell tumor over the region of the right maxilla.

tains many blood vessels. There are a number of foci composed of cellular connective tissue, in which are numerous large multinucleated cells. No definite inflammatory reaction is observed, but there are a number of small hemorrhages and necrotic areas in the connective tissue with the formation of cystic areas. Diagnosis: benign giant cell tumor of the bone."

Roentgen treatment was given for the lesion. The patient was not seen until six years later, when she was again admitted complaining of pain in the right side of her face. The enlargement of the right maxilla was no greater, producing slight asymmetry of the face. The roentgen report was as follows: "There is quite a bit of increased density over the region of the right maxillary antrum,

apparently due to thickening of the bone rather than to any particular material in the antrum."

The roentgen therapy was repeated. Unfortunately a biopsy was not made at this time. It would have been exceedingly interesting to compare the histologic appearance with that of the specimen removed six years earlier.

This lesion although histologically diagnosed as benign giant cell tumor has many of the characteristics of the lesion in case 5. The main

Fig. 18 (case 6).—Photomicrograph of benign giant cell tumor (× 100) showing presence of bone tissue and cellular fibrous tissue in which there are numerous multinucleated giant cells.

distinguishing feature is the numerous giant cells. However, as one may see in examining the histologic picture in cases 3 and 4, multinucleated cells occur in lesions considered to be osteomas, although they are much less numerous. The similarity is certainly sufficient to indicate, as stated earlier in this paper, that the two pictures represent

different stages of the same pathologic process rather than two distinct pathologic entities. The osteoma may be the secondary element and signify a terminal product in a series of transformations of tissue which began as a giant cell tumor.

In summarizing the histologic study of these lesions one sees that those in cases 1 and 2 can be considered primarily as true neoplasms or osteomas of the compact variety. The spontaneous origin, progressive course, circumscribed form and composition of simple compact bone give a definite picture of tumor formation. In cases 3, 4 and 5 the growths have rather typical gross and clinical features indicative of true osteomas, but they cannot be differentiated as such by the histologic study because of the presence of features which are also characteristic of other hypertrophic lesions of bone, namely, the so-called fibrocystic group. In other words, they may be lesions which have taken on secondarily neoplastic properties but which primarily began as another process—probably a reparative process in response to injury or trauma.

The last case was cited to illustrate the similarity grossly and histologically of typical giant cell tumor to the tumor formation of the osteoma in case 5.

SUMMARY

In a study of hypertrophic changes and tumor formations in bone lesions of the nose and sinuses one finds that in contrast to the well established gross and clinical features of the lesions there is a great deal of uncertainty as to the pathologic interpretation. The majority are treated as osteomas and are thought of as neoplasms.

Osteoma as a true neoplasm has not been clearly distinguished from other forms of overgrowth of bone. It appears to be pathologically related to the so-called fibrocystic group of bone lesions. Because of the number of instances in which one finds that it combines the clinical features and histologic characteristics of both giant cell tumor and osteitis fibrosa one feels that they may be closely allied, and the possibility of a common cause must be considered. Some form of trauma seems to be the most important etiologic factor. Some other metabolic or nutritional disturbance may be necessary to account for such an abnormal reaction, and further clinical and histologic investigation should be carried out to establish the basic nature of these processes. A better understanding of the etiologic factors may reveal that in the cases in which the lesion cannot be definitely proved to be a true neoplasm, radical surgical intervention with the attendant deformity, in an attempt to eliminate the condition, is not necessary.

Dr. Baxter L. Crawford helped in the study of the histologic sections, and Dr. Carl J. Bucher, in the translation of the foreign texts.

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VASCULAR FIBROMA OF THE NASOPHARYNX (NASOPHARYNGEAL FIBROMA)

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CAUSES

Vascular fibroma of the nasopharynx, an interesting and peculiar type of tumor, occurs chiefly in males and rarely in females between the ages of 10 and 25 years and seems to be related to the growth and maturation of the bones of the base of the skull. Consequently spontaneous regression can and does occur, though infrequently. The neoplasm is not common but is of the utmost importance because of an active growth which may interfere with various functions. Ulceration and local infection may take place, or severe anemia may result from repeated hemorrhage, while fatal consequences from intracranial extension or from injudicious attempts at removal are not uncommon. A tendency toward recurrence is typical. In this country, Delavan [1] has contributed extensively to the existent knowledge of the growths.

SITE OF ORIGIN AND GROWTH

The tumor is thought to originate in the periosteum of the bones which arise from the embryonal occipital plate (the basilar process of the occipital bone, the body of the sphenoid, the medial pterygoid process and the bones in the region of the foramen lacerum and the pterygopalatine fossa) and the anterior aspect of the first two cervical vertebrae.[2] Its growth is slow and expansive, and it may invade the pharyngeal, nasal or paranasal cavity, the superior or inferior orbital fissure, the regions of the masseteric compartment and the temporal fossa, the foramens at the base of the skull or the cribriform plate (fig. 1). It may be difficult to determine the site of origin of the tumor because of this extensive growth, the susceptibility to profuse bleeding on manipulation and the secondary attachments which may occur. Although the tumor neither metastasizes nor infiltrates tissue in the manner of sarcoma, its spread is destructive, because of pressure necrosis.

From the Department of Otolaryngology, Rush Medical College.

Read before the Chicago Laryngological and Otological Society, April 3, 1939.

1. Delavan, D. B., in Jackson, C., and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1930, p. 181-186.
2. Ringertz, N.: Acta oto-laryng., 1938, supp. 27, pp. 1-405.

PATHOLOGIC PICTURE

Macroscopically the fibroma may be pink to deep red and may resemble a nasal polyp. Microscopically it is made up principally of connective tissue and an unusually large number of blood and lymph vessels.[3] In the latter respect the tissue differs from that of true fibroma and, for the sake of accuracy, might more appropriately be termed "vascular fibroma" or "angiofibroma." The connective tissue is for the most part collagenous, and the reticulum is shown by Foote stains to be of delicate texture. Elastic connective tissue is infrequent.

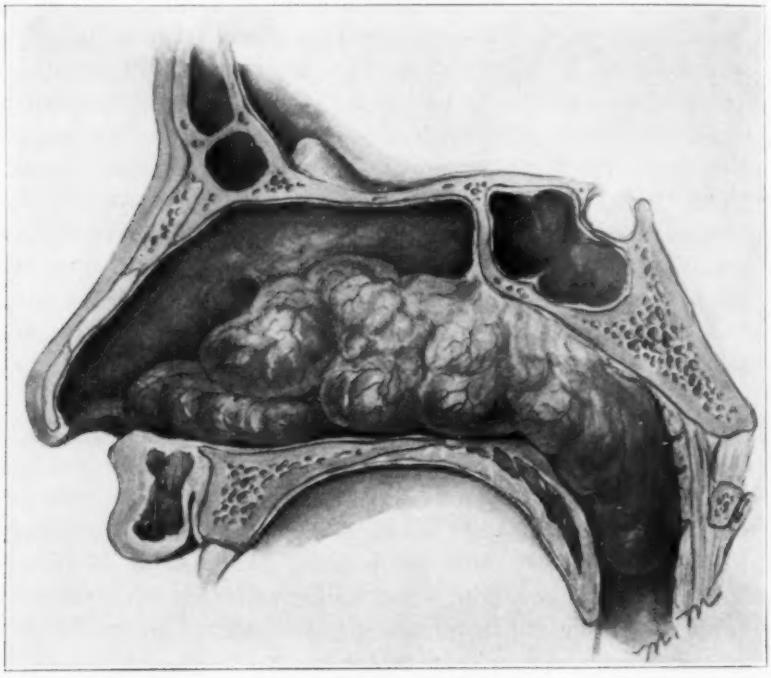

Fig. 1.—Extensive vascular fibroma of the nasopharynx. The apparent site of origin is at the base of the sphenoid sinus (Lederer [6]).

The fibroblasts may be round or spindle shaped and have a tendency to appear in focal distribution. The cells may be immature and their number greater than in adult connective tissue. In fact, isolated areas may be suggestive of sarcoma. The blood vessels are thin walled, vary in size and may even be cavernous. Because they are embedded in fibrous tissue and lack a muscular layer, the vessels do not collapse when cut and hence bleed profusely.

3. Ewing, J.: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1934, p. 181.

Calcification, cartilage and osseous formations have been described in connection with this tumor. During retrogression or involution, changes of the walls of the blood vessels may ensue, with resulting necrosis, fatty degeneration or hyalinization of the tumor.[3]

The surface of the neoplasm is covered by mucous membrane, the epithelium of which may undergo metaplasia. No evidence of formation of a capsule is apparent. In contrast to teratoid tumors, not infrequently observed in this region, there is a lack of smooth muscle fibers.[4]

In summary it may be repeated that, while histologically benign, vascular fibroma of the nasopharynx is clinically malignant in its growth.

SYMPTOMS

In the early stages there may be no symptoms, but once the growth has attained sufficient size, obstruction to nasal respiration usually becomes manifest. The increased size may be responsible for changes in the character of the voice, suppuration in the accessory sinuses and obstruction to the eustachian orifices, with deafness or disease of the middle ear. Bleeding is one of the most important symptoms and may be either spontaneous or induced by attempted removal. Surface ulceration causes early bleeding, while fatal hemorrhage may result from involvement of large vessels.[5] Extension into the pharynx may produce dysphagia. Severe and intractable pain is apt to be the consequence of pressure on nerve trunks.

With the spread of the tumor into the sphenoid and ethmoid regions, optic atrophy, proptosis and even basilar meningitis ensue, while invasion of the maxillas may lead to the often described "frog face" deformity. Anemia from repeated loss of blood and cachexia from toxic absorption further burden the patient. Spontaneous regression, though occasionally noted between the ages of 25 and 30, cannot be relied on, particularly in young persons or in adults whose existence is threatened by the extent of the growth.

DIAGNOSIS

In addition to the usual methods of examination, the nasopharyngoscope may be employed with benefit, especially in searching for recurrences. Roentgenograms, particularly basal and lateral views of the skull, are helpful in defining the extent of the tumor. If necessary, examination with the patient under general anesthesia should be performed. Biopsy is essential, although if vascular fibroma is suspected one might well defer the procedure until irradiation has decreased the vascularity of the growth. Surgical diathermy is invaluable for the con-

4. Henke, F., and Lubarsch, O.: Handbuch der speziellen Pathologie und Histologie, Berlin, Julius Springer, 1926, vol. 3, pp. 222-224.

5. Goldsmith, P. G.: J. Laryng. & Otol. **38**:565-574, 1923.

trol of any bleeding which follows examination or removal of tissue for microscopic study.

The question of differentiation from sarcoma may arise, but correlation of clinical and microscopic aspects should be decisive in this respect. It is questionable whether this tumor ever undergoes malignant degeneration.

Lederer [6] has pointed out that adenoid masses, particularly after attempted removal, may resemble fibroma and that, conversely, an abnormality is sometimes not considered until repeated unsuccessful attacks on the nasopharynx have been made. Teratoid tumor, hemangioma and lymphangioma deserve consideration, as, of course, do the more common varieties of nasal or choanal polyp. The last are lighter in color than true vascular fibroma, do not bleed as freely and present a widely different histologic picture. It must be remembered that malignant chordoma occurs in this region. Carcinoma of the nasopharynx is not as uncommon in younger persons as was formerly thought and should always be excluded.

REPORT OF CASES

CASE 1.—M. B., a boy aged 11, was first examined by Dr. T. C. Galloway on May 11, 1934, because of purulent postnasal secretion. The tonsils were large and spongy, and there was thought to be a polyp above the right middle turbinate bone. Tonsillectomy and adenoidectomy were performed on June 29, and at that time a mass was discovered filling the right choana and extending from above the middle turbinate to the lower palatal border. The mass measured about 3 by 2 cm., was of firm, boardlike consistency and cut with great difficulty with the snare. It seemed to be attached above the orifice of the right eustachian tube. Bleeding was fairly profuse but controllable with pressure. The tissue was examined microscopically and vascular fibroma was reported.

Radon seeds were implanted into the pharyngeal mass for two years, between October 1934 and October 1936, with a total dose of 1,900 millicurie hours. There was a decrease in the tumor and some accompanying atrophy of the turbinate, but a definite growth persisted in the region of the eustachian tube.

In November 1936, with the patient under anesthesia induced by nitrogen monoxide and ether, nasopharyngeal examination was performed, a Haslinger palate retractor being employed. A snare was passed through the nose. By means of visualization and palpation the tumor was engaged and removed with coagulating current. Grossly the tissue was roughly spherical, measuring 22 by 18 by 20 mm. The histologic diagnosis was benign fibroma, and histologic evidence of any effect of irradiation was not present (fig. 2).

After this removal the nasopharynx was smooth. The right maxillary sinus was dark on transillumination, but the finding was ascribed to a sinal infection due to previous blockage. Some months later, because of epistaxis without gross signs of recurrence, a roentgenogram was taken; a mass was noted which filled the medial two thirds of the right antrum (fig. 3). The patient then began to

6. Lederer, F.: Diseases of the Ear, Nose and Throat, Philadelphia, F. A. Davis Company, 1938, p. 425.

complain of headache on excessive activity and stooping. There was a slight fulness over the right cheek and brow.

In July 1938, with the patient under anesthesia induced by avertin with amylene hydrate, an incision was made through the right canine fossa with the idea of ligating the internal maxillary artery as a preliminary measure. A soft friable tumor was encountered which bled freely when touched. The right external carotid artery was ligated with little effect on bleeding. (In retrospect it appears that radium, roentgen rays or radon should have been used at this time, with subsequent removal of the tumor.) The operation was continued, with coagulation

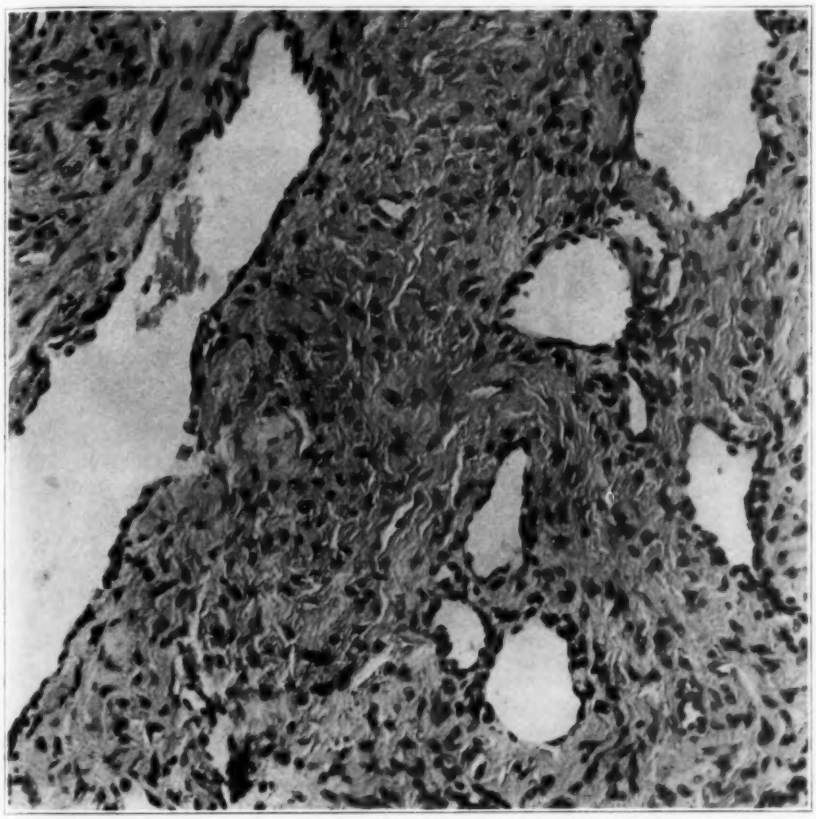

Fig. 2 (case 1).—Section of vascular fibroma after two years of radiation therapy. This section does not show alterations as compared with those removed prior to irradiation. The histologic picture is typical of the growth, with fibroblasts and thin-walled vessels predominating.

and removal of tissue by forceps but despite suction the field was almost entirely obscured by blood. The tumor nearly filled the antrum and had eroded its posterior wall in the medial half, filling the sphenomaxillary fossa. Removal seemed complete after coagulation and Luc forceps had been used, though the internal maxillary artery or its branches could not be visualized. Bleeding was controlled by iodoform packing. The loss of blood was estimated at 700 cc., and a transfusion

was given immediately. A postoperative blood pressure of 70 systolic and 40 diastolic later rose to 116 systolic and 50 diastolic.

Four days later, on July 11, the packing was removed, and profuse hemorrhage ensued. The internal maxillary artery was ligated, but packing had to be reinserted. The operation was discontinued because of the poor condition of the patient, and the blood pressure rose to 180 systolic and 50 diastolic for no known cause. The antrum and the nasal fossa were packed and the sublabial incision left open. Several days later, when the packing was again removed, the resulting oozing seemed to emanate from several large veins and arteries in the vicinity, which were ligated, the procedure including the sphenopalatine artery and a large branch going to the inferior turbinate. The operative field then became dry, but a petrolatum gauze pack was left in situ. When this was removed, five days later, there was no further bleeding, and the sublabial wound had healed without suture. The patient's hemoglobin had decreased from 15 Gm. (97 per cent) to 10 Gm. (64 per cent).

Fig. 3 (case 1).—Roentgenogram illustrating recurrence of growth. The original tumor had completely disappeared, and the recurrent mass had grown into the right antrum via its posterior wall and the sphenomaxillary fossa.

Microscopic examination of the tissue disclosed epithelium of the respiratory tract covering a cellular tumor with a fibrous stroma and many small to medium-sized vascular channels.

In September and again in December examination of the antrum and sphenomaxillary space (by means of a nasopharyngoscope passed through the antrum window) did not reveal evidence of any tumor tissue.

Case 2.—C. M., a boy aged 15, had been having frequent nosebleeds and nasal obstruction for one year when first seen by Dr. T. C. Galloway, in June 1937. The epistaxis had been occurring with increasing frequency. There had been many head colds, and the patient had lost weight. The family history was noncontributory. Two previous attempts had been made to remove a mass from within the nose, both of which had been attended by severe bleeding. On examination

a growth was seen filling the left nasal chamber nearly to the vestibule and extending into the nasopharynx as a 3 cm. red, rounded mass attached by a somewhat smaller pedicle. The neoplasm was smooth and covered by dilated vessels and bled profusely when touched with a rounded forceps. The bleeding was controlled by packing for one hour and coagulating diathermy. Biopsy revealed a cellular vascular fibroma, the fibroblasts being ovoid to spherical, with sparse chromatin and a prominent nucleolus. Lymphocytes, macrophages and plasma cells were notably absent.

With the patient under local anesthesia, six 1 millicurie gold radon implants were inserted into the body of the tumor. Bleeding was moderately profuse but controllable with diathermy. There were 4,560,000 red blood cells, 71 per cent hemoglobin, and 11,550 white blood cells, per cubic millimeter. Four months later, after eight additional 1 millicurie gold radon implantations, the original mass

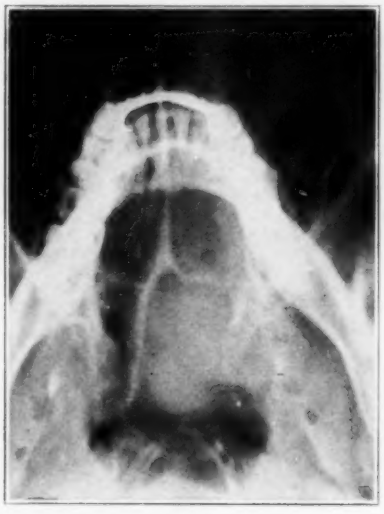

Fig. 4 (case 3).—Roentgenogram illustrating a large shadow of soft tissue in the region of the left sphenoid.

was approximately one-third its original size and firmer and bled much less readily. A total of 1,862 millicurie hours of radon had been used thus far.

In March 1938 the growth extended posteriorly from the anterior tip of the left middle turbinate into the nasopharynx and was adherent to the choanal border of the turbinate and the nasal septum in this region. In filling the left choana, it seemed to arise from a pedicle above the orifice of the eustachian tube. With the patient under anesthesia induced by avertin with amylene hydrate and nitrogen monoxide, the nasal and nasopharyngeal masses were electrocoagulated and then removed with coagulating snare and forceps. The left external carotid artery was ligated because of severe bleeding. All raw surfaces were coagulated and desiccated, and iodoform packing was inserted. There was mild postoperative shock, and the packing was removed in twelty-four hours, with no further bleeding. Biopsy disclosed benign capillary hemangiofibroma, and appreciable changes in the histologic picture were not present.

Considerable crusting appeared subsequently, and in April a small sequestrum of the anterior wall of the sphenoid sinus was removed. In September a small vascular region near the posterior remnant of the middle turbinate received 400 millicurie hours of radon. Biopsy of this tissue, however, revealed only a chronic inflammatory (plasmocytic) reaction, with none of the fibrovascular characteristics of earlier specimens.

In December the previously involved areas were smooth and clean save for a small mass seen through the defect in the sphenoid. One 1 millicurie radon

Fig. 5 (case 3).—Section of the original tumor showing typical vascular fibroma. The extreme cellularity is noteworthy.

seed was implanted, the total dose being brought to 2,400 millicurie hours. The patient had gained 20 pounds (9 Kg.) and was playing basketball, and the only difficulty, some crusting, was controlled by daily nasal douches.

Case 3.—Mr. A. L., aged 26, was first seen by Dr. L. T. Curry on Jan. 6, 1938, at which time he told of having had marked nasal obstruction on the left side for one year. During the week prior to examination there had been frequent spontaneous hemorrhages from each side of the nose. There had not been pain

or aural symptoms. On anterior rhinoscopic examination, a large red tumor was seen filling the region normally occupied by the left middle turbinate and obscuring all but the anterior tip of the inferior turbinate. This mass bled profusely during attempts to shrink the blocked passage. On posterior rhinoscopic examination, a similar tumor was observed filling the entire left side of the nasopharynx superiorly, blocking the left choanal opening and extending partially across the right choana, obscuring the septum. There was a slight bluish discoloration over the handle of the malleus on the left tympanic membrane. The right ear was normal. Cervical enlargements were not present.

Fig. 6 (case 3).—Lateral roentgenogram showing radon seeds in situ.

Roentgenograms of the sinuses (Dr. H. Potter) were reported on as follows: "The principal finding is on a vertical view through the sphenoid region, where a large open space devoid of original bony elements is shown. This corresponds to about the proper position for the left sphenoid. The bony defect is at least 1½ inches (4 cm.) in width and nearly 2 inches (5 cm.) in anteroposterior direction. While bony elements are gone, this region contains the shadow of a soft mass which corresponds undoubtedly to the mass visible in the nasopharynx (fig. 4). The left frontal and ethmoid sinuses also are opaque, whereas the left antrum seems to be clear." Wassermann and Kahn tests on the blood were negative.

Biopsy of the tumor (S.A.F.) was reported on as follows: "In sections stained with hematoxylin and eosin an epithelial layer is not present, nor are there any apparent characteristics of mucous membrane of the respiratory tract. A dense cellular infiltration is in the nature of a compact connective tissue stroma, with the fibroblast as the predominant cell, interrupted by numerous capillaries and small blood vessels. Various stages of maturity of the fibroblasts may be recognized, the type most frequently encountered being an elongated spherical cell

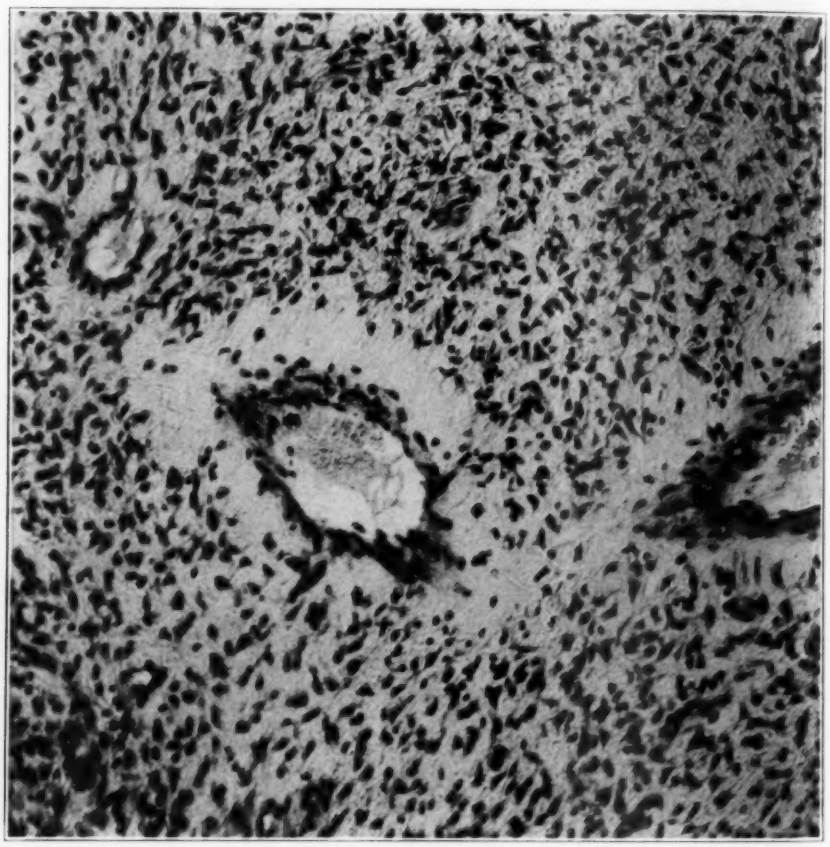

Fig. 7 (case 3).—Section of vascular fibroma illustrating involutional changes which either resulted from or coincided with irradiation. The perivascular thickening is marked.

with a moderate chromatin content. A nucleolus is evident in approximately 50 per cent of these cells. Next in frequency is an ovoid, rounded fibroblast with similar chromatin and nucleolar distribution. Only an occasional lymphocyte is evident. The vascular spaces are lined by endothelium and contain mostly erythrocytes, with an occasional polymorphonuclear leukocyte or monocyte. Perivascular changes or cellular reactions other than the fibroblastic activity described are not present (fig. 5)."

Between January 13 and March 31 the patient received 600 milligram hours of radium directly on the tumor within the nose and the nasopharynx. There was a resultant decrease in both size and vascularity of the growth. The spontaneous epistaxis had ceased after treatment was instituted and bleeding on manipulation had become progressively less marked.

On April 29 seven 1 millicurie radon seeds were implanted directly into the tumor via the nasopharynx. In June further roentgenograms showed the radon seeds in situ (fig. 6). In August, after submucous resection, the nasal fossa was almost completely clear save for synechia and a small mass overlying the middle turbinate far posteriorly. This seemed to communicate with the nasopharyngeal tumor, which had become relatively small in the vault of the pharynx. A portion

Fig. 8 (case 3).—Lateral roentgenogram showing retraction of the tumor and radon seeds toward the base of the skull. The figure should be compared with figure 6.

of the tumor was removed intranasally with surgical diathermy. There was some bleeding, and 10 radon seeds averaging 1 millicurie each were implanted into the nasopharynx via the nasal fossa.

Observations at biopsy at this time differed from those on the previous section in several respects: "The stroma is less compact and individual bundles of collagenous connective tissue may be easily distinguished, principally because edematous spaces produce wider separation of the cells. The fibroblasts exhibit less variation in size and shape, the majority having elongated nuclei with tapering cytoplasmic processes at their extremities. Plasma cells are present in increased number. There is definite thickening of the perivascular spaces in the form of a prominent fibroedematous zone surrounding each vessel. Traversing these zones

are occasional fibroblasts arranged in a radiating pattern (fig. 7). In sections of the same tissue stained with Mallory's aniline blue, the connective tissue stroma becomes accentuated, and erythrocytes filling the vascular spaces are brilliant red. Particularly prominent is the layer of perivascular connective tissue previously mentioned. In sections stained by the Foote method only a delicate reticulum formation is apparent."

In December a marked atrophic condition was noticeable in the left nasal fossa. Crusting was controlled with nasal irrigations. Lateral roentgenograms showed a marked retraction of the tumor and radon implantations toward the base of the skull (fig. 8). Vertical views through the sphenoid further illustrated the decrease of the growth. On mirror examination only a small reddened area was visible in the nasopharynx. This extended from the superior border of the torus tubarius medially along the upper choanal border into the posterior end of the septum. There was merely a slight fulness in this region and no actual tumor tissue. The sinuses were clear and the ears normal. A total of 600 milligram hours of radium and 2,250 millicurie hours of radon had been used.

In March 1939, the condition had not altered, and signs of recurrence were not present.

TREATMENT

Any perusal of the literature cannot but impress one with the importance of an accurate diagnosis and the desirability of rational therapy in dealing with this tumor, for it is not uncommon to find reports of deaths resulting from attempts at operative removal, although these have been less frequent in recent years. Extensive surgical resection involving the nose, palate or maxillas no longer has a place in the treatment of vascular growths. Avulsion with the cold snare should probably be abandoned because of the attendant hemorrhage and shock and the possible damage to the attached bones at the base of the skull, from the periosteal layers of which the growth may have arisen.[7] I have had no experience with attempts at reduction in the vascularity of the tumor by the injection of escharotics.

The use of radium was first suggested by Delavan [1] some years ago, and New and Figi [8] reported from the Mayo Clinic a series of cases in which this treatment was adopted. In these cases the radium was administered by holding lead applicators against the tumor, inserting needles or implanting radon. Roentgen rays also have been employed, either solely or in combination with radium.[9] More recently, surgical diathermy, alone or together with irradiation, has been proposed.[10]

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7. Allan, F. G.: Nasopharyngeal Fibroma, Arch. Otolaryng. **19**:215-223 (Feb.) 1934.

8. New, G. B., and Figi, G.: Am. J. Roentgenol. **12**:340-342 (Oct.) 1924.

9. (*a*) Berven, E., and Heyman, J.: Report of Cases Radiologically Treated at Radiumhemmet, Stockholm, P. A. Norstedt & Sons, 1929. (*b*) Koch, J., and Eigler, G.: Arch. f. Ohren-, Nasen- u. Kehlkopfh. **142**:1-14 (Oct.) 1937.

10. New, G. B., and Havens, F. Z.: S. Clin. North America **12**:939-945 (Aug.) 1932.

I believe that this combination, irradiation and surgical diathermy, offers by far the most satisfactory therapeutic approach. In general, it should be said that the type of treatment will depend somewhat on the age of the patient and the extent of the tumor. Radiation therapy may be regarded as the most effective means of reducing the extreme vascularity of the tissue and should probably be used as a preliminary measure in all instances. Since the growth rarely produces symptoms until it has reached considerable size, it is doubtful whether irradiation alone will suffice. (An exception may be found in the case of adults approaching the age of 25 to 30, when spontaneous involution sometimes occurs. In such a situation radiation may hasten the appearance of regressive changes.) The hemorrhagic propensity of the tumor having been materially reduced by radiation therapy, removal of the remaining portion may be most safely effected by surgical diathermy, with the opportunities thereby afforded for the control of any severe or troublesome bleeding. It appears that this routine entails less hazard than one in which the sequence of events is reversed, i. e., wherein initial removal by diathermy is followed by implantation of radon, as suggested by New and Havens.[10] In either event ligation of the external carotid or internal maxillary artery may be a valuable adjuvant.

Although it has been advocated that this tumor should be treated exclusively by irradiation,[9a] it must be recognized that complete disappearance of the growth would probably require a higher total dose than could be safely tolerated. The aim is therefore to initiate physiologic retrogression, but this cannot be depended on as a constant effect. Furthermore, the sensitivity of the nasal mucosa to irradiation is well known, and atrophic changes may result even from mild doses, as exemplified in the cases here reported. In addition, it is necessary to avoid radiation necrosis because of the danger of infection of the middle ear and osteomyelitis of the adjacent bones.

In the choice of various forms of radiation therapy I favor implantation of radon seeds into the tumor. As a preliminary measure it is often advisable to apply radium directly in the form of needles or with a well shielded applicator or to use roentgen rays or teleradium. In the cases presented, a striking reduction of troublesome bleeding rather rapidly followed the institution of irradiation. If the tumor is large, various portions may be treated effectively by implantation of radon and the damage to normal structures minimized. The average strength of each seed should be approximately 1 millicurie. Change in the position of the implants, as seen roentgenographically, provides further information as to the status of the growth.

After irradiation and the removal of the tumor by diathermy, any remnants or recurrences are readily amenable to treatment by further implantation of the radon seeds or electrocoagulation.

SUMMARY AND CONCLUSIONS

The term "nasopharyngeal fibroma" is somewhat a misnomer and should, on histologic grounds, be modified. The designation of the tumor as "vascular fibroma" or "angiofibroma" is perhaps more appropriate.

Three cases are reported, in which treatment by a combination of irradiation and surgical diathermy has been successful.

An attempt was made to analyze the histologic alterations resulting from irradiation in these 3 cases. In 2, definite changes could not be observed in sections of tissue removed for study before and after treatment. In the third the alterations noted microscopically were a diminution in the compactness of the collagenous connective tissue bundles, maturation of fibroblasts, infiltration of plasma cells and definite fibroedematous perivascular zones producing an apparent thickening of the walls of the blood vessels. Because the patient had reached an age at which involutional changes might be expected, it is possible that therapy was the factor responsible for initiation of retrogressive changes, particularly since no evidence of such changes were apparent in the original biopsy taken seven months previously.

Despite the absence of significant histologic changes following irradiation in 2 of the 3 cases reported, a definite decrease in the vascularity of irradiated areas was noted clinically. This clinical alteration greatly facilitated subsequent removal of tumor tissue. The validity of this observation was borne out by an attempt to remove a recurrent tumor in the maxillary antrum. No irradiation had been used, and an almost uncontrollable hemorrhage resulted.

Because of the attachment of the tumor to the bones of the base of the skull and the involvement of these bones by pressure necrosis, it is suggested that avulsion with the cold snare should be abandoned.

The combination of irradiation and surgical diathermy offers a safe and effective method of treatment for vascular fibroma of the nasopharynx.

Drs. T. C. Galloway and L. T. Curry gave me the opportunity of studying the histologic specimens and the clinical records of the cases and permitted me to make this report.

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INFECTION WITH ASPERGILLUS NIGER

REPORT OF TWO CASES

LEON FELDERMAN, M.D.
PHILADELPHIA

The 2 cases to be reported in this paper tell the story of a disease which eludes detection through the ordinary method of examination. Diagnosis, then, is difficult and often at fault. Afterward, when the physician knows beyond peradventure that he has to deal with a fungous infection, the applied therapeusis becomes relatively simple. The diagnosis can be arrived at only through laboratory technic, and the germicide used must be selective.

Since Micheli,[1] 1729, described Aspergillus and named it because of its resemblance to "rough head," mycologists have identified nearly four hundred species of the family.[2]

In 1842, Benet established its pathogenicity for man, and the pathologist Virchow demonstrated it in the lungs post mortem.

Siebenmann[3] placed the proportion of aural infections due to Aspergillus at 1 per cent. The frequency of the infection in China earned for it the name of "Hong Kong ear." It is not uncommon in India and is listed as an occupational disease found in handlers of grain, hair sorters, workers with sponges and those who feed pigeons by placing the grain in their mouths.

REPORT OF CASES

My patients both complained of pain accompanied by intolerable itching of the organs involved, nervous irritability, insomnia and headache.

CASE 1.—A housewife aged 33 was referred to the office with a provisional diagnosis of "impacted cerumen, bilateral." The family physician's diagnosis was accepted. The canals of the ears were freed from the impacted mass by washing. The membrana tympani was found to be congested and bulging in the vicinity of the Shrapnell zone, for which condition treatment was administered. In the

1. Micheli, F.: Aspergillus capitulo pulla, nova plantarum genera, 1729, p. 212.

2. Thom, C., and Church, M. B.: The Aspergilli, Baltimore, Williams & Wilkins Company, 1926, p. 168.

3. Siebenmann, F.: Die Fadenpilze Aspergillus flavus, niger und fumigatus; Eurotium repens (und Aspergillus glaucus) und ihre Beziehung zu Otomycosis aspergillina, Ztschr. f. Ohrenh. **12**:124-161, 1883; Wiesbaden, J. F. Bergmann, 1883.

course of five days, the patient returned with the external canals of the ears filled with the same substance. This time she complained of pain at the tip of the mastoid. On washing the canals of the ears, a greenish black wax was delivered, and at the end one could see a light greenish corkscrew form, which led to the suspicion of a fungous mass. The washings were immediately referred to the laboratory for study, and the report identified the organism as Aspergillus niger. Methylrosaniline, which had been used in the treatment, was replaced by an ointment of silver picrate, 10 per cent. After complete removal of the mass, the use of the ointment was continued, and the patient was kept under observation for a few months. As no recurence of the mass in the ear was evident, she was discharged as cured.

CASE 2.—A woman aged 43, a cutter in a lace curtain factory, about a year ago complained of intense itching in the region of the nose, which was aggravated at night, causing insomnia. At the same time, her attention was drawn to the presence of a membrane in the interior of the nose, which not only filled the vestibule of the nose but extended to the lower edges of the middle turbinate. As the condition was bilateral, mouth breathing, with the attendant dry condition of the oronasopharynx, made speech hoarse and difficult. When the membranes were removed there remained a bleeding surface which reformed in about six or eight hours. The patient had visited five physicians at different times, and remedies prescribed had been of no avail. One physician made a diagnosis of "athlete's feet of the nose." At the time the patient consulted me the membrane was thick and of a distinct pinkish hue, obliterating the nasal passages. At first, the condition suggested pseudodiphtheritic membrane of a fungous growth. To reproduce the fungi in a proper culture (Sabouraud's medium) [4] was difficult. Cultures of material from the nose and throat were made, and the report from the laboratory was as follows:

"Microscopic examination of scabs from the nose on a preparation of sodium hydroxide did not reveal fungi. A Gram smear showed numerous epithelial cells and white blood cells and a few gram-positive diplococci. On Sabouraud's culture fungi were not isolated within seven days. Cultures of material from the nose revealed Staphylococcus aureus, neisseria flavus and Bacillus coli. The growth in Sabouraud's culture was of the Aspergillus type (identified by Dr. F. Weidmann)."

The composition of the culture medium used to reproduce the fungus follows:

"Sabouraud's conservation agar contains water, 1,000 cc.; peptone, 10 Gm., and agar, 18 Gm. For isolation and study of the organisms, Sabouraud's test agar, 1908, contains 40 Gm. of crude maltose."

Topical applications of methylrosaniline (5 per cent) found the membrane of the nose resistant, so that it was found expedient to change to local applications of an ointment of silver picrate (10 per cent), which produced an immediate improvement. The applications continued for several weeks. Since the membrane did not reform, the patient was discharged as cured.

It should be instructive and helpful to consider briefly the fungus responsible for this disease.

The Aspergillaceae [5] are a large family of fungi. They have a rapid, prolific and complicated system of growth. It is noteworthy that the

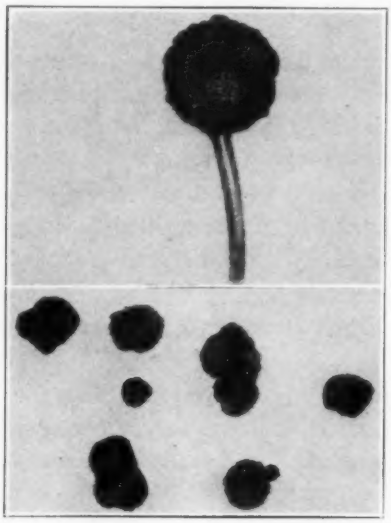
4. Dodge, C. W.: Medical Mycology, St. Louis, C. V. Mosby Company, 1935, p. 51.

5. Dodge,[4] p. 610.

periods of fertilization, flourishing and decline are swift, with the first two stages well developed before the host is aware of their presence.

Microscopically, they are recognized in many forms: Some are shaped like Irish lace; some resemble a sunburst; some are pelican shaped; some are flasklike, and some are shaped like umbrella sticks. There are various dimensions and sizes. The fungi may be bright or dull brown.

They are found in anemic plants which lack chlorophyll. This vegetative growth is ameboid. The ability which the fungi possess to reproduce themselves with ease is amazing, the two methods being fertilization and fusion of two nuclei.



Aspergillus niger heads (photographs by Mitchell L. Dratman, Thom and Church [2]); above, black, fairly regular head on a smooth stalk (× 260); below, organism in Petri dish, representing a globose head partially splitting.

Among some of the elements necessary for reproduction and growth are (*a*) water, (*b*) high humidity, (*c*) a carbon and nitrogen supply in suitable relation to the hydrogen ion concentration and (*d*) light.

The cases given in the literature on the subject of A. niger show that the regions most frequently infected are the ear, the nose, the mouth, the tongue and the lungs. This is not a complete list but is sufficient to arouse the interest of the laryngologist and thus make him familiarize himself with a pathogenic organism which is increasingly common, undoubtedly largely because of the modern method of transportation. The automobile, the motor trailer and the aeroplane are the chief carriers of mycotic infections. It is interesting to note and should be

helpful in future diagnosing to remember that these infections have been mistaken for syphilis, tuberculosis, cancer, diphtheria and many other diseases.

One of the primary symptoms of fungous infection of the canal of the ear is dermatitis affecting the external auditory canal.[6] The examination discloses a red area with considerable shedding of the superficial layer due to intolerable itching. In cases of infection with A. niger, the accumulation of debris is rapid, with associated impairment of hearing.

There are fungi in addition to A. niger about which the practitioner knows but little. It will be informative to consider some of them because of the perplexing symptoms to which they give rise, which often lead to faulty diagnoses.

Jakowski,[7] as early as 1888, reported infection with Absidia ramosa in the human ear, an unknown mycotic infection. Since then the parasite has been successfully isolated from mucus of the upper air passages in the lower animals (cows, horses, swine).

Aspergillus siebenmanni [8] has been isolated from the human ear and apparently belongs to the Aspergillus flavus group but cannot be identified with certainty.

Macfie [9] reported an aspergillus which causes a mycotic infection of the ear with itching and irritation of the canal without affecting the hearing.

Penicillium minimum [10] is of interest because the fungus was isolated in a case of catarrh of the middle ear following scarlet fever. Three years later the organism was still present in a membrane, showing how resistant it is to ordinary germicidal treatment.

Castellania copelli [11] is found in lesions which appear on the tongue and has proved pathogenic to rabbits and guinea pigs.

Mycoderma pararogosum [12] is found abundantly in sputum. The patient has a productive cough with mucopurulent expectoration. The advanced condition resembles phthisis; the patient is emaciated and has a hectic fever with bloody sputum. Yellowish gray patches in the

6. Whalen, E. J.: Fungous Infections of the External Ear, J. A. M. A. **111:** 502-504 (Aug. 6) 1938.

7. Jakowski, cited by Dodge,[4] p. 113.

8. Lucet, A., and Constantin, J., cited by Dodge.[4]

9. Macfie, J. W. S.: Notes on Some Fungal Infections in West Africa, Ann. Trop. Med. **15:**279-281, 1921.

10. Dodge,[4] p. 641.

11. Dodge,[4] p. 252.

12. Dodge,[4] p. 219.

throat resemble those seen with diphtheria. Physical examination adds to the confirmation, but a microscopic examination of the fungus rules out pulmonary tuberculosis.

Candida bethaliensis [13] is another form of parasite invading pulmonary tissue, causing symptoms resembling those of tuberculosis. It was isolated from the sputum of a patient who suffered from cough, leukocytosis, febrile attacks and hemorrhages.

Pseudomonilia allesandrina [14] also is isolated from mucopurulent sputum in cases of bronchitis.

Mekundu [15] has been isolated from sputum in cases of bronchitis in inhabitants of Belgian Congo. A history of malaria, bronchitis and fever at first suggested undulant fever.

CONCLUSIONS

1. Aspergillosis of the upper air passages must occur with greater frequency in North America than the reports in the literature indicate.

2. Modern methods of transportation introduce molds and fungi from distant countries.

3. The growth of fungi in certain culture mediums is relatively slow, and one must allow a few weeks before the mold can be reproduced.

4. Silver picrate ointment has fungicidal properties and proved efficacious in the 2 cases reported.

Central Medical Building, 1737 Chestnut Street.

13. Dodge,[4] p. 229.
14. Dodge,[4] p. 295.
15. Dodge,[4] p. 350.

Case Reports

EXPULSION OF FOREIGN BODY FROM THE ANTRUM WITH THE AID OF IRRIGATION

E. R. Hargett, M.D., Springfield, Ohio

Recently I have successfully employed irrigation by means of a trocar in a series of cases of infection of the antrum following extraction. The patients did not have a history of any foreign body having entered the antrum, although a few of them had fistulas. Treatment was started soon after the dental work had been done. Roentgenograms of the antrum were not taken in the majority of the cases. The following case is cited as unusual in the series:

A 26 year old nurse presented herself at my office complaining of pain in the left cheek, aching in the small joints of the hands and feet and general malaise. Nine days previously, the upper left third molar had been extracted. The present illness began two or three days later. It was recalled that a small piece of gauze had been left in the cavity by the operator and had not been recovered, supposedly having been swallowed or expectorated.

Examination revealed a healed extraction cavity and findings leading to a diagnosis of empyema of the left antrum. A quantity of green, foul-smelling pus was removed by irrigation, with relief from the local pain and general symptoms the next day. Several more irrigations were carried out at two day intervals. The day after the fifth irrigation the patient became conscious of a mass high in the left nostril. After a few minutes of blowing her nose she obtained a small piece of gauze from the left nostril. She brought this specimen to the office. It was 0.5 cm. wide and 2 cm. long, a typical small piece of dental packing. Within a few days the antral washings returned clear and she was discharged as cured.

According to the dental operator, a fragment of root was not left in the cavity and the tooth came out cleanly. It is interesting to note that the foreign body would not have shown on roentgenograms. Although the gauze may have been carried to the natural ostium by the irrigations, it apparently did not come out directly at the time of the washing but was carried through by ciliary motion in the presence of severe infection. Another unusual point in the case is that, although there was a large perforation into the antrum, with a foreign body and empyema, a fistula did not form.

First National Bank Building.

PAGET'S DISEASE OF THE BONES OF THE SKULL WITH OBLITERATION OF THE SINUSES

JOHN H. CHILDREY, M.D., SAN FRANCISCO

Paget's disease, or osteitis deformans, first described in 1877, is a disease of unknown cause, usually affecting a number of bones and occurring in patients over 40 years of age. It may be [1] a general disorder in which at present only the osseous changes are known. Formerly considered rare, it is known to be merely unusual, and with more roentgenograms the disease, no doubt, will be recognized oftener, particularly in its earlier stages. Osteitis deformans affects especially the skull, vertebrae and bones of the leg although it may be confined to one bone. The sacrum, spinal column, femur and cranium are oftenest affected,[2] but the disease may commence in the skull or maxilla.

Although the cause is unknown, it is thought by some that the disease has a vascular origin (endarteritis), possibly embolic, so closely do the lesions resemble the distribution of carcinomatous metastases in bone. Others, because of the similarity of the histologic picture, which is one of rarefaction of osseous tissue and its replacement by young, actively growing fibrous tissue, think that osteitis fibrosa, osteitis deformans and osteomalacia are one condition, differing only in the age and vitality of the patient. It has been shown in some cases that the sclerotic lesions of Paget's disease developed in a few years about the osteoporotic lesions of osteoporosis circumscipta of the skull, and some believe the latter to be the absorptive phase of Paget's disease or at least a related precursor, although Paget's disease affects the vault (fig. 2) while the other condition usually begins in the frontal and occipital bones near the base (fig. 1 *B*). Sosman [3] mentioned a patient who improved considerably under roentgen treatment of the parathyroid glands. However, with Paget's disease, unlike the situation with osteitis fibrosa, the patients are older; formation of bone has outstripped its destruction; there is no accompanying hyperparathyroidism; the values for calcium and phosphorus in the blood are normal, and there is no parathyroid hyperplasia. The concentration of phosphatase in the serum, normally 1 to 5 units (Bodansky) per hundred cubic centimeters, may in

1. Moore, in discussion on Kasabach, H. H., and Gutman, A. B.: Osteoporosis Circumscripta of the Skull and Paget's Disease: Fifteen New Cases and a Review of the Literature, Am. J. Roentgenol. **37**:577-602 (May) 1937.

2. Schmorl, G.: Ueber Ostitis deformans Paget, Virchows Arch. f. path. Anat. **283**:694, 1932; cited by Boyd,[4] p. 978.

3. Sosman, in discussion on Kasabach, H. H., and Gutman, A. B.: Osteoporosis Circumscripta of the Skull and Paget's Disease: Fifteen New Cases and a Review of the Literature, Am. J. Roentgenol. **37**:577-602 (May) 1937.

severe Paget's disease be increased to 30 or 40 units. However, Boyd [4] stated the objection to such comparisons that replacement of fibrous tissue is not a specific lesion but is observed in a variety of osseous bone diseases.

Osteitis deformans begins with softening, at which time the affected bone is often painful, and continues with overgrowth of the bone. During the softening, characteristic deformities occur, and when the skull is affected it may become much thickened and enlarged. The face usually is not involved, but occasionally the facial bones become much thickened, giving the appearance of leontiasis ossea (fig. 3 *A*), and the maxilla may become so large that the maxillary teeth telescope over the lower teeth when the mouth is closed [5] (fig. 3 *B*). Deformities of vertebral bones may result in spinal curvature, while those in the long bones of the extremities result in thickening and bowing, so that the figure is shortened. Although progressive, the disease usually is not fatal. However, arteriosclerosis is often marked; fractures and pseudofractures may occur, and there is a tendency toward the development of osteogenic sarcoma.

The roentgen picture is characteristic, even before any deformity has appeared, but it varies with the phase in which the disease is seen. After the stage of primary softening, in which bone is replaced by connective tissue (fig. 2), the bone becomes hard and thicker, for ossification predominates, and there is a heavy deposit of subperiosteal finely porous cancellous bone on the long bones and on the skull, making the surfaces rough and irregular (fig. 4 *A*). The affected bones are thick and dense, although the medullary cavity is widened. The vault of the skull presents a peculiar serrated appearance (fig. 4 *A*). There is a complete metamorphosis, for the normal structure disappears and new bone is laid down on a massive scale (fig. 1 *A* and *C*).

Two of the most interesting features of the microscopic picture are the great number and the irregular arrangement of the lamellar systems, individual in appearance and having what is known as a mosaic structure due to variously shaped areas of new and old bone separated by ground substances.[4] The medullary cavity is filled with fibrous tissue.

The differential diagnosis should present no difficulty, for the various conditions from which the disease is to be distinguished in the osteoporotic stage, such as cholesteatoma, mucocele, hyperparathyroidism, gumma and various tumors and their metastases, are characterized by destruction of bone, while in Paget's disease, as in osteoporosis circumscripta, decalcification alone occurs and the architecture of the bone remains intact.

The sclerotic lesions of Paget's disease may be confused with healed tuberculous lesions and also must be differentiated from hyperostoses, syphilitic osteitis and Albers-Schönberg disease. The last occurs in childhood.

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4. Boyd, W.: A Textbook of Pathology, ed. 2, Philadelphia, Lea & Febiger, 1934, pp. 970-972.

5. Stafne, E. C., and Austin, L. T.: A Study of Dental Roentgenograms in Cases of Paget's Disease (Osteitis Deformans), Osteitis Fibrosa Cystica and Osteoma, J. Am. Dent. A. **25**:1202-1214 (Aug.) 1938.

REPORT OF CASES

CASE 1.—R. L. P., a man aged 24, came for an examination on Oct. 16, 1937, because he believed the glasses he was wearing were not improving the poor vision of his left eye, which he had noticed for many years. This eye seemed to him to have been on a higher level than the right for as long as he could recall. His face was markedly asymmetric, with considerable bulging of the forehead, a condition he attributed to a forceps delivery at birth. He stated that he was not born until some days after labor normally should have occurred and that five days after the membranes ruptured a prolonged delivery with forceps was done. He

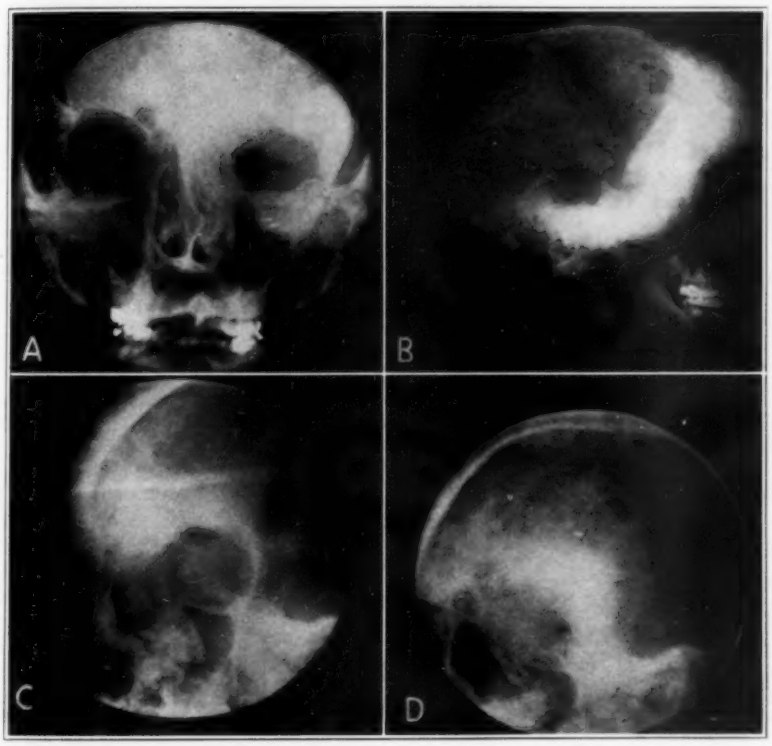


Fig. 1 (case 1).—Extensive involvement of the maxilla and the sphenoid and frontal bones. Note the narrowing of the optic foramens and the almost complete obliteration of the frontal, ethmoid and sphenoid sinuses.

was found to be considerably myopic, but with correction his vision was 100 per cent in the right eye and 70 per cent in the left. It was felt that the refractive error did not explain the impaired vision in the left eye. The media and the fundi were normal. The left eye was 12 mm. above the plane of the right (fig. 1 *A*). Studies done with a perimeter at this time and three months later gave essentially the same results and showed slight contraction of the temporal fields.

Examination of the ear, nose and throat gave essentially negative results. Roentgenograms of the skull showed marked hyperostosis and sclerosis of the bones of the anterior and middle fossae, with great thickening of the bones of

the supraorbital region (fig. 1 *B*). There were involvement of the horizontal frontal plate and increased density of the ethmoid labyrinth, and the sphenoid was solid bone with no evidence of a sinus. The optic foramens were both smaller than normal because the surrounding sphenoid bone encroached on them (fig. 1 *C* and *D*). Involvement of the bones was more marked on the left side of the head, there being apparently no left frontal sinus and little, if any, air space in the left ethmoid labyrinth, and the floor of the nose was lower on the left side than on the right (fig. 1 *A*). The cranium was involved as high as the vertex. The Wassermann and Kahn reactions of the blood were negative; the urinalysis gave normal results; the blood pressure was 134 systolic and 69 diastolic, and physical examination showed no other abnormality, revealing no apparent involvement of other parts of the skeleton.

The striking osseous changes were probably the cause of the signs of involvement of the eye. In this case the location of the lesion, that is, in the frontal bone primarily, near the base, and the age of the patient, only 24, both favored the diagnosis of osteoporosis circumscripta. In fact, the disease in this case had been

Fig. 2 (case 2).—Early stage of Paget's disease. The lesion is limited to the vertex.

present many years and must have begun in childhood. However, the roentgen appearance was characteristic of osteitis deformans, for there were both osteoporosis and sclerosis. Such a case lends support to the belief that the two conditions are interrelated. It seems questionable whether the trauma of childbirth was of etiologic importance. Noteworthy is the deformity of the skull and its consequences, namely, obliteration of the air spaces of the sinuses or failure of their development and the narrowed optic foramens. As remarkable, though not unusual, is the lack of discomfort.

Case 2.—Mrs. J. V., a woman aged 45, came in June 1931 for an examination of her eyes, the vision of the left eye being limited to ability to see fingers at 2 feet (61 cm.) and that of the right being 30 per cent, because of bilateral posterior staphylomas and changes in the macular regions. The media and the fundi were normal. The perimeter showed the fields to be irregular, bilaterally contracted with central blurring on the left. The tangent screen bilaterally gave the impression of bitemporal defects. Roentgenograms of the teeth and sinuses were normal, but those of the skull showed thickening of the calvarium, most marked in the parietal bones, characteristic of Paget's disease (fig. 2).

Ten years previously a large posterior staphyloma had been found in the left eye. Studies of the visual fields at that time showed a central scotoma on the right, and the vision of the right eye was 4.5/20 and that of the left eye 4.5/75.

The vision of the left eye continued to fail, and early in 1932 it was 3 per cent. The patient returned in 1935 because of severe dizziness of several weeks' duration, which was diagnosed as subsiding toxic irritation of the right labyrinth. Some six months earlier she had undergone an extensive gynecologic operation, complicated by thrombophlebitis in the right thigh. The vision was now 60 per cent in the right eye and 33 per cent in the left. The media and the fundi were as before except for the presence of many glistening floaters. Unfortunately no more roentgenograms were made.

Case 3.—Mrs. M. M. W., a woman aged 59, came to the hospital on Jan. 30, 1937, because of failing vision in both eyes noticed for a year and associated with occasional shooting pains in the eyes. She wished glasses, if advisable. She presented a strange appearance; she was short and squat; her back was bent and

Fig. 3 (case 3).—Photograph of the patient, showing extensive involvement of all the bones of the skull. The mandible is not affected.

the shoulders sagged. She did not wear a hat; her head was large, as was the upper portion of the face, so that both gave her a leonine appearance (fig. 3). Vision in the right eye was 5 per cent, and that in the left 10 per cent, of normal. Examination of the eyes with the aid of eucatropine hydrochloride anesthesia showed the lens to contain slight diffuse and peripheral opacities, more marked nasally and below and more marked in the left eye. There were marked temporal pallor and depression of the optic disks, white patches and degenerative changes in the macular regions and evidence of scattered hemorrhages. On refraction slight hyperopic astigmatism was found, and little improvement of vision was obtainable in the right eye with correcting lenses. The intraocular tension was 40 in the right and 52 in the left eye. Charts made with the perimeter showed marked bilateral contraction of the visual fields. Charting with the tangent screen was impossible because of the poor vision.

Roentgenograms of the skull showed thickening and a generalized wooly appearance of all bones except the mandible (fig. 4); the nasal accessory sinuses were obliterated, as were the mastoid air cells, and the upper cervical vertebrae were

involved as well. There were numerous deposits of dense sclerotic bone throughout. Roentgenograms of the spine, pelvis and most of the long bones confirmed the diagnosis of advanced Paget's disease.

Ethylmorphine hydrochloride and pilocarpine hydrochloride were advised for use in the eyes at home. Six months later vision had continued to fail and hearing became impaired. At this time she began having dull and at times severe pains with swelling in the arms, and pain in the back made walking impossible. The pain became more persistent and severe, so that opiates became necessary. In October,

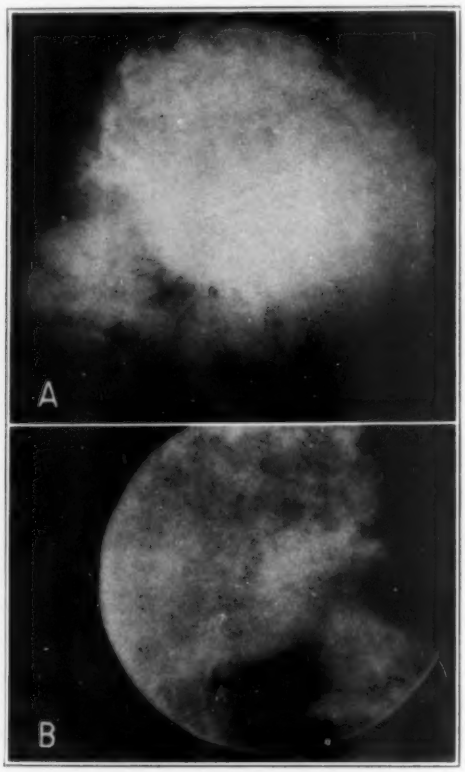


Fig. 4 (case 3).—Advanced Paget's disease of the skull. The air spaces of the sinuses and mastoid are obliterated.

the thighs became anesthetic; the right knee swelled, and the right arm was so swollen and weak that she could not lift the hand. The cheek bones became more prominent; the chin seemed more pointed, and large swellings appeared on the skull. Her mind remained clear. She died on November 19. An autopsy was not performed, but from the history it is suspected that osteogenic sarcoma was the cause of death.

Greens' Eye Hospital.

Clinical Notes; New Instruments and Technics

CORRECTION OF SADDLEBACK DEFORMITIES OF THE NOSE BY SPECIALLY CUT CARTILAGE FROM THE EAR

F. HARBERT, M.D., PHILADELPHIA

The most common causes of saddleback deformities are abscess of the septum, too complete a submucous resection, trauma and some congenital anomalies. There is a growing and justifiable tendency to correct more moderate deformities, especially for persons in whom they cause a feeling of inferiority; but until recently only the more extreme deformities were routinely operated on. Beck and Guttman [1] cautioned against operating on patients who are psychically unstable or in whom the psychic disturbance is out of proportion to a minor defect, lest the operative procedure serve as a basis for a new obsession.

The saddleback nose is one of the easiest and most satisfactory of deformities to correct. The methods and materials are varied, however. Inert transplants, such as paraffin, gold, silver, celluloid and ivory, have been practically abandoned, although there are still some staunch advocates of the use of ivory.[2] The main objections are the rigidity of these materials and their tendency to be expelled. Bone transplants have likewise been abandoned, because they are too easily absorbed. Rib cartilage has the advantage of being available in large quantities, but its tendency to curl often changes a fine initial result into a caricature. When large defects are to be corrected this chance must be taken, however. Septal cartilage has the disadvantage of being absorbed either wholly or in part, so that the final result is unpredictable. Recently the use of cartilage preserved in aqueous solution of merthiolate has become increasingly popular, because the percentage of takes compares favorably with that when living tissues are used.

The advantages of auricular cartilage over all other transplants are its flexibility, its permanence in size and shape when transplanted and its subsequent growth as a living integral part of the body. Another advantage is the complete regeneration of cartilage at the site of removal from the ear. This takes place in from six to twelve months. When cartilage from the ear is utilized, strips are usually cut and inserted until the desired effect is produced, or strips are sewn together with catgut to form a single graft suitable for the defect. The objection to these methods is that the pieces tend to slip with the former and that the amount of flat cartilage suitable for building up a graft is limited with the latter. In fact, the greatest objection to the use of cartilage from the ear is the small amount available.

The object of this paper is to propose a method of cutting the cartilage which takes full advantage of the thickest part of the cartilage and produces a single piece of grafting cartilage admirably adapted to fill the usual saddle nose defect. This method has been used with gratifying results, and, as will be seen, the technic is simple.

The opinions and assertions contained herein are the personal ones of the writer and are not to be construed as official or as reflecting the views of the Navy Department or of the Naval Service at large.

1. Beck, J. C., and Guttman, M. R.: Recent Advances in Plastic and Reconstructive Surgery of the Ear, Nose and Throat, Am. J. M. Sc. **196**:875, 1938.

2. Wolf, G. D.: Correction of Saddle Nose, Arch. Otolaryng. **22**:304 (Sept.) 1935.

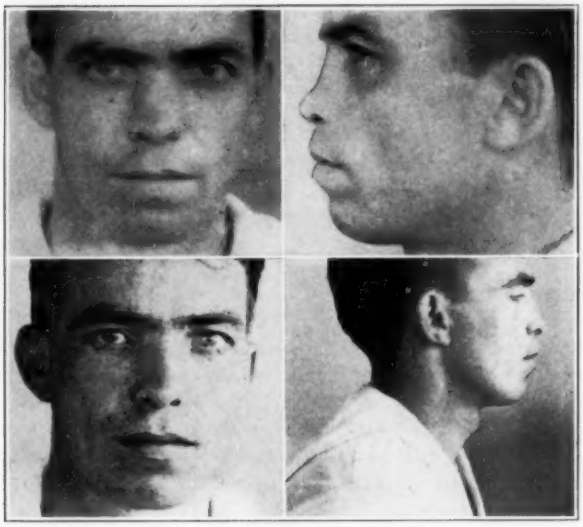


Fig. 1.—Above, front and side views of patient with congenital saddleback deformity. Below, front and side views of same patient three months after operation according to the technic described here.

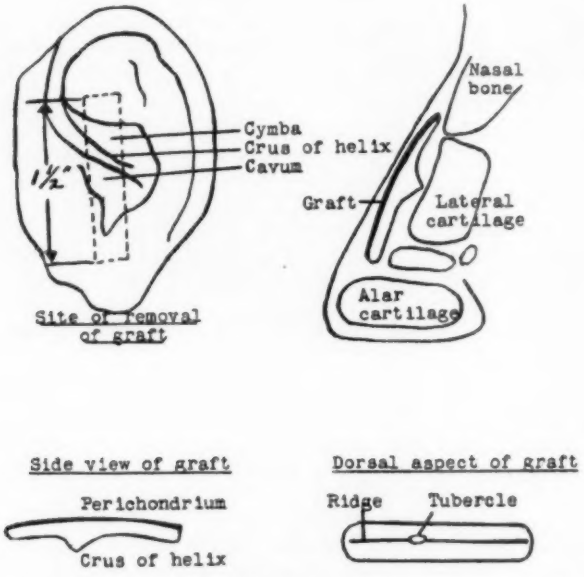


Fig. 2.—Schematic drawing showing graft of cartilage from the ear and its relations when transplanted into the nose.

With the area under anesthesia produced by infiltration of 1 per cent procaine hydrochloride and epinephrine hydrochloride, a long incision is made in the crease at the junction of the ear and the scalp. The skin over the dorsal aspect of the pinna is elevated, with exposure of the perichondrium. The elevation should proceed until the vertical ridge on the dorsal aspect of the cartilage and its tubercle lie in the middle of the operative wound but are still covered by perichondrium. A strip of cartilage is then outlined with a Freer or a Bard-Parker knife, about ⅜ inch (1 cm.) in diameter and about 1½ inch (3.8 cm.) long, with the vertical ridge extending downward from the tubercle exactly in the middle of the strip. The crus of the helix should be near the middle of the ventral aspect. The incision is made down to but not through the perichondrium on the anterior aspect of the concha and the strip elevated with a submucous elevator, the anterior perichondrium being left intact. The excised strip with attached dorsal perichondrium is now trimmed to the shape shown in the diagram and to a size suitable for the defect to be corrected.

The nose is prepared for the reception of the graft by tunneling over the dorsum through an incision in the gap between the lateral and the alar cartilages. The nasal injection of procaine hydrochloride should be kept to a minimum in order to avoid distortion of landmarks and to permit accurate correction of the defect. Too wide a tunnel should be avoided in order to keep the graft from slipping. When the graft is inserted it is apparent that the crus of the helix greatly helps to fill in the central defect without adding to the weight and thickness of the graft. The convex curve of the dorsal perichondrial surface prevents the ends of the graft from projecting through the skin, and the ridge on this surface produces a sharp nasal bridge. The tubercle and the undesirable bumps have, of course, been trimmed off before insertion of the cartilage. The incision is closed by a single suture, and a wide piece of adhesive plaster over the dorsum of the nose completes the nasal dressing. It is well to close the incision in the ear last in order to permit the procurement of additional cartilage should it be required. The incision is nicely closed with vertical mattress sutures and a mastoid dressing applied after the cavum conchae has been filled with cotton, which produces a firm and continuous pressure and prevents the formation of hematoma. Except for slight postoperative swelling, lasting a few days, convalescence is uneventful, and infection has not been encountered.

United States Naval Hospital.

CORRECTION OF LATERAL DISPLACEMENT OF FREE BORDER OF THE SEPTAL CARTILAGE

F. Harbert, M.D., Philadelphia

Lateral displacement of the free border of the septal cartilage is a common finding in any clinic where many submucous resections are performed. This displacement produces:

1. Protrusion of the free border of the septal cartilage in one nostril instead of lying between the cutaneous surfaces of the columella.

2. Displacement of the inferior edge of the septal cartilage lateral to and below the anterior inferior nasal spine and the groove of the vomer, allowing the tip of the nose to drop.

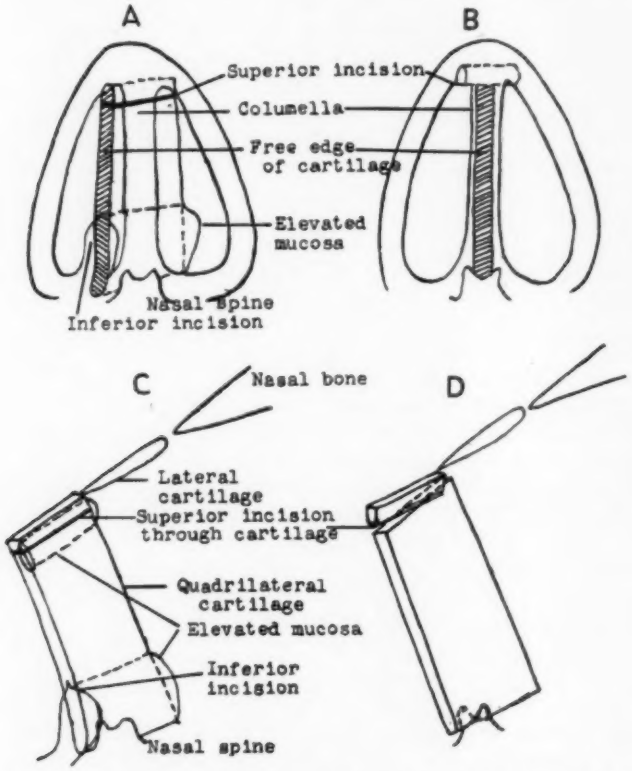
The opinions and assertions contained in this report are personal ones of the writer and are not to be construed as official or as reflecting the views of the Navy Department or of the Naval Service at large.

3. Pulling of the columella to the side of the protruding cartilage and enlargement of the opposite nostril.

4. Curling of the septal cartilage with the concavity on the side of the protruding edge. Usually the curling is sufficient to cause obstruction on the opposite side because of the convex bulge.

A classic submucous resection in such cases will obviously not relieve nasal obstruction.

Various methods of replacing the cartilage without submucous resection, of which the methods of Metzenbaum and Cohen are examples, have been advocated.



A, view of the nares showing the free edges of the quadrilateral cartilage displaced in the right naris. The lower margin of the cartilage lies lateral to and below the nasal spine. *B,* view of the nares showing the replacement of the free edge of the cartilage within the columella, the lower margin resting in the groove of the nasal spine. The upper strip of cartilage remains deviated. *C,* side view of the strip of quadrilateral cartilage remaining after submucous resection. The mucosa has been elevated along the inferior margin and near the carina nasi. Through the upper mucosal incision the cartilage is incised, leaving a narrow strip above and the lower segment freely movable. *D,* side view of the strip of quadrilateral cartilage after the replacement of the lower margin in the groove of the nasal spine showing the rotation of the lower segment on the upper strip.

These are probably excellent for children, in whom submucous resection may interfere with subsequent development of the nose. In the adult presenting this picture, however, the septum will usually have secondary deviations producing the classic S-shaped deformity, ridges and spurs which require submucous resection to restore the airway.

Such an expedient as excising the protruding edge has the objection of not correcting the depressed tip but instead further removing support for it. Moreover, it will not correct the obstruction caused by the convex bulge in the opposite nostril. Peer [1] advocated complete excision of the deviated and dislocated quadrilateral cartilage and inserted a support from a straight piece of this cartilage. In cases in which the anterior segment of the cartilage is hopelessly deformed and thickened, this is probably the method of choice. Fortunately, the majority of these dislocations leave the cartilage intact except for smooth curves of deformity and make them particularly amenable to correction by the simple procedure advocated here.

A classic submucous resection is performed first and complete healing permitted. Usually a month suffices, but the procedure is equally applicable years after the original submucous resection. With the area under anesthesia produced by infiltration of 1 per cent procaine hydrochloride and epinephrine hydrochloride a small vertical incision, about ⅜ inch (1 cm.) long, is made over the lowermost aspect of the protruding septal tip. The mucosa is elevated on both sides of the cartilaginous strip to its posterior extremity, the lower ⅜ inch of the strip and its inferior edge thus being exposed.

Through the same incision, the groove in the anterior inferior nasal spine is deepened by incisions and if necessary by excisions with the Freer knife. It will now be found that the lower part of the septal cartilaginous strip is freely movable. If not sufficiently mobile, it can be made so by elevating the mucosa slightly higher. In some cases the cartilage can now be lifted into the groove of the anterior nasal spine, and the cosmetic and functional result will be good. Usually, however, the upper attachment of the cartilage will produce tension and tend to cause recurrence of the subluxation, or the upper portion of the free border of the cartilage will still protrude. In such cases an incision about ¼ inch (0.6 cm.) long is made at the junction of the septal cartilage and the carina nasi. The entire junction is exposed by elevating the mucosa on one side only with a septal elevator, through a channel as narrow as possible. A Freer knife is now introduced through this channel and the septal cartilage incised down to but not through the mucosa of the opposite side. Lateral movements of the entire septal strip are now easy, because it remains attached only to the mucosa in its middle portion on both sides. The strip is placed in position in the groove of the nasal spine, and it will be found that there is no tension and no tendency for slipping. The proper position of the strip is maintained by splints of dental wax and/or light gauze packing. Its vitality is assured because of extensive attachments of mucoperichondrium remaining.

There are usually slight postoperative swelling and thickening of the columella when the packing is removed twenty-four hours later, and this persists for about a week or more. It is surprising how the redundancy of mucosa, which is often noticeable at first, disappears in the course of a few weeks, leaving an excellent cosmetic and functional result.

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1. Peer, L. A.: An Operation to Repair Lateral Displacement of the Lower Border of the Septal Cartilage, Arch. Otolaryng. **25**:475 (April) 1937.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology.

FUNCTIONAL EXAMINATION OF HEARING

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The literature of the past year contains a relatively small contribution on the functional examination of hearing. Hardly any new tests or practical variations of the old ones have been published. Audiometry is used to a greater extent in the testing. The few articles found in the foreign literature show definite activity in this field. Interest in the testing of school children and in the interpretation of results is evident. Considerable attention is being given to hearing aids and their development and use.

Holmgren [1] has written a complete monograph on hearing tests and hearing aids. He reviews the procedures, evaluates the criticisms and gives his own views obtained from investigations carried out in the otorhinolaryngologic clinic, Sabbatsberg Hospital, Stockholm. He traces the development of hearing tests and hearing aids and presents the fundamental acoustic principles and their relation to speech and hearing. One cannot ascribe any great value to comparative auditory examinations unless they are conducted in a sound-proof room or under identical conditions of noise. Papers dealing with results of hearing tests with no information on the acoustic conditions under which the results were obtained cannot be given serious consideration in a scientific discussion. Holmgren discusses the practical value of conversation and whispering tests and tuning fork tests from an acoustic standpoint. He describes the construction of an electrically activated tuning fork to be used for obtaining the most reliable values for hearing by bone conduction. Bone conduction tests with tuning forks should be done not only with forks of 128 double vibrations but also with those of higher pitch, up to 1024 double vibrations. The value for hearing by bone conduction obtained with 128 double vibrations represents a functional test of the cochlea for this frequency only.

1. Holmgren, L.: Hearing Tests and Hearing Aids, Acta oto-laryng., 1939, supp. 34, p. 1.

A critical survey of the prevalent construction of audiometers is made and the possible sources of error discussed. Holmgren presents the advantages of the loud speaker used on the audiometer employed in his clinic as compared with the receiver placed against the ear. Values for the air conduction are obtained without any additional effect from the bone conduction. The loud speaker gives exact intensity at the same distance from the ear, while the intensity from the receiver varies considerably if it is pressed with varying firmness against the ear. There are no variations for resonance and no variations in the threshold caused by different dimensions of the auditory canal and the outer ear with the loud speaker as contrasted with the receiver. Measurements made with the loud speaker of the sound-amplifying effect of hearing aids are made under acoustic conditions identical with those under which they are intended to be used. The receiver, on the other hand, is more easily portable and less expensive and conducts less sound to the other ear. In comparing tuning forks with the audiometer, Holmgren concludes that with the exception of the measurement of frequencies of 32 and possibly 64 double vibrations the audiometer yields more complete, more reliable and speedier results than the tuning forks. This takes into consideration, however, an audiometer furnished with thoroughly correct and trustworthy measuring instruments. Since in dealing with a complicated electrical instrument the possibilities or sources of error are always present and have to be considered, he advises the control of audiometric readings by means of some simple tuning fork tests.

Holmgren presents, further, a critical survey of hearing aids, their description, the ways and means for prescribing and testing them and the benefits that can be obtained for persons with the different types of impairment. He brings out the difficulty of compensating perceptive loss of hearing due to the "recruitment phenomenon." The superiority of the tube amplifier in comparison with other constructions is emphasized. The principal dissimilarities between loss of hearing of the conductive and that of the perceptive type are as follows: In the conductive type, the lower tones and the intelligibility of the vowels alone are affected; perception of speech is considerably weakened, though it sounds clear and is understandable even with relatively great loss of hearing; the intelligibility slowly decreases with increased distance from the source of sound, and weak tones and noise are not heard at all; suitable hearing aids are easily procurable with the amplification arranged so as to shift the audition curve parallel upward toward the normal; the qualitative intelligibility of speech is not changed with amplification. In loss of hearing of the perceptive type, the higher tones and the intelligibility of consonants alone are affected; the perception of speech is not weakened to any great extent, but it appears indistinct and is appreciated with

difficulty even with loss of hearing for a relatively small range of tones; the intelligibility decreases quickly with increased distance from the source of sound, but weak tones and noise of low frequencies can still be heard—the patient has to make a great effort to interpret what he hears; hearing aids can be fitted only with great difficulty even with the use of tube amplifiers, and the amplification is best arranged in a selective manner corresponding with the loss curve, the recruitment phenomenon with regard to the same being taken into consideration; the amplified sound seems qualitatively changed, and adaptation to the degree of selective amplification which gives the best intelligibility must take place successively. Holmgren emphasizes especially the characteristic of perceptive deafness that speech is heard distorted even though total sound perception may be only slightly diminished. This distortion has been overlooked by many makers of hearing aids. As a result, they have had the opinion that the amplification should be arranged parallel with the patient's curve of threshold value rather than selectively. This opinion might be due to the lack of consideration of the recruitment phenomenon and the need of successive adaptation to the correct degree of selective amplification.

Holmgren describes in detail a special audiometer which he has built to overcome the imperfections of the audiometers on the market today. He has made valuable additions in order to take up physiologically correct curves for the threshold and to aid in trying out hearing apparatus. He utilizes a new technic of measurement, which he calls the "sliding tone," which implies that various points on the curve of the threshold are measured by maintaining a constant intensity and continuously varying the frequency, while with all other described methods, including those using the tuning fork and the audiometer, constant frequency must be kept up and the intensity varied. This continuous variation of frequency with simultaneous readable exact intensity of tone as constructed in his audiometer has definite advantages. Physiologically one utilizes a more nearly correct testing of the function of the auditory organ; from the otologic standpoint, the hearing tests are superior, partly in the presence of noise and partly in the prevention of the use of stationary waves, and from a technical standpoint the method is the only serviceable one for measuring the various effects of improvement in hearing within the different frequencies from which the amplification for speech can be calculated. A complete description of this audiometer is given in the monograph.

Any one interested in hearing and hearing aids should read this complete résumé with important conclusions, criticisms and suggestions made by Holmgren. A complete bibliography, in which American otologists are well represented, accompanies it.

Hill [2] brings out the advantages and value of the monochord for testing the upper limit of hearing for both bone and air conduction. He confirms Bunch's contention that it is the best device available for testing the upper limits. The chief handicap is its construction and the impossibility of measuring the intensity of its tones. The monochord has practically the same amplitude for both air and bone conduction. Normally the monochord is heard from 1000 to 2000 double vibrations higher by bone conduction than by air, which suggests that hearing by bone conduction is actually better than by air conduction. Tests with the monochord show that lesions in the middle ear definitely produce certain degenerative processes in the internal ear. According to Dean and Bunch, lowering of the upper limit of perception by bone conduction is more indicative of a lesion of the nerve or end organ than lowering of that by air conduction. Occasionally, the use of the monochord may materially change the audiometric picture and give a different conception of the condition. The audiogram may show a loss of hearing by bone conduction at frequencies of 1024 and above and yet the monochord may be heard up to 15000 double vibrations by bone conduction. In another case the same loss may be observed with the monochord also. The interpretation of the two conditions is different as regards the status of the internal ear. One is justified in assuming more severe involvement of the nerve in the second case than in the first. Patients showing a lowering of the upper limit of perception by air conduction may have normal upper limits for bone conduction, disclosing little destruction of the nerve mechanism for the high tones. However, if the upper limit for bone conduction is greatly lowered as shown by the audiometer and the monochord, one may assume the presence of severe perceptive deafness. The monochord is a valuable instrument and can be used routinely to advantage with the tuming forks and the audiometer in the functional tests of hearing.

Aschoff and Bayer [3] bring out the fact that otologists in the last decade have concentrated on several basic points concerning hearing tests. These are continuous production and unvarying energy of the test tones, testing of each ear independently of the other and testing of intensity of tone in relation to intensity of speech. Their studies of tuning forks, the monochord and the Bárány noise apparatus disclosed limitations in the use of these instruments. They found overtones present when testing perception of the lower tones with the tuning forks. These were eliminated by the application of weights or by using

2. Hill, F. T.: The Use of the Monochord in Routine Tests of Hearing, Laryngoscope **49**:666 (Aug.) 1939.

3. Aschoff and Bayer: Contribution on the Question of the Physical Bases for the Use of Weighted Tuning Forks, Monochords, and Bárány Noise Apparatus in Hearing Tests, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:77, 1939.

Bezold-Edelmann forks, which are overtone free. Quantitative and qualitative measurements of the upper and lower limits of audition are difficult to obtain with the monochord and tuning forks because of the fluctuation and the temporary lapse in the intensity of the sound waves produced. The results obtained with the Bárány noise apparatus did not follow any well defined course and were subject to great variation. The writers point out that nonelectrical instruments should not be underrated and that they will always play an important part in diagnostic studies. However, tuning forks and monochords do not come up to present day standards which the audiometers set by pure tone and volume control and the device by which the sound can be instantly produced or cut off.

Greenbaum, Kerridge and Ross [4] undertook an investigation to ascertain the normal range of hearing by bone conduction by testing a large number of young, healthy adults in a silent room, with an audiometer. Seventy-four men and 26 women were chosen, whose ages ranged from 18 to 25 and who had never had any aural disease.

The test tones were of frequencies of 64 to 8192 cycles in octave steps. The point of application on the mastoid of the receiver for testing hearing by bone conduction varied with each subject according to the optimum position for hearing as determined by changing the position of the receiver.

The average curve plotted from the results closely resembles that given in the instruction bulletin of the Western Electric audiometers, gradually increasing from 25 decibels at 64 cycles per second to 55 decibels at 512 cycles and then gradually decreasing to 25 decibels at 8192 cycles. However, the individual results showed somewhat wide variation. This emphasizes the fallacy of labeling bone conduction abnormal when a determination on a patient is compared with a measurement on a single so-called normal person.

Watkyn-Thomas [5] presents the etiologic factors of internal ear deafness, dividing them into two main groups, lesions of the nerve trunk and its central connections, and lesions of the middle ear. He does not believe there are any means available for distinguishing between a lesion sharply limited to the nerve trunk and a lesion of the cochlea. A diagnosis of internal ear deafness must never be made until one is sure by actual proof that the eustachian tube is patent and the drum membrane mobile. He has found a disparity often in the limit of perception for high tones as disclosed by the monochord and by the audiometer, the latter usually showing a greater loss. An attempt to estimate the intensity

4. Greenbaum, A.; Kerridge, P., and Ross, E. J.: Normal Hearing by Bone Conduction, J. Laryng. & Otol. **54**:88 (Feb.) 1939.

5. Watkyn-Thomas, F. W.: Internal Ear Deafness, Proc. Roy. Soc. Med. **32**:487 (March) 1939; J. Laryng. & Otol. **54**:273 (May) 1939.

of the sound produced by the monochord might help to clear up this point. An important point in differentiating primary internal ear deafness and secondary nerve deafness due to otosclerosis is the patient's reaction to noise. The otosclerotic patient is either helped by noise or indifferent to it.

Watkyn-Thomas discusses a group of cases in which deafness occurs in the early forties with no definite etiologic factor. The audiograms are characterized by a sharp fall in the perception for high tones. He believes that the condition is due to toxic influences either blood borne or received via the middle ear. The most important, he feels, are the endogenous toxins produced by focal lesions. Bilateral deafness due to syphilis is a diminishing problem. Noise also is a factor to be considered. It is important to remember that in every case of internal ear deafness the most trivial and transitory additional middle ear deafness adds disproportionately to the patient's discomfort.

Perlman [6] reports a case of hyperacusis due to paralysis of the stapedius muscle in which hearing for sounds at and above the threshold, auditory fatigue and adaptation were carefully investigated. His findings corroborate those previously recorded on the action of the stapedius muscle and the part it plays in the function of hearing. Perlman, with Lindsay and Kobrak, in 1936 found that the threshold of the muscular contraction is about 65 decibels above the threshold of hearing, that the muscle does not enter into the mechanism of hearing for sounds under 65 decibels and that its function is probably to protect the cochlea when sounds of sufficient intensity and of sudden onset reach the ear. He suggests that two types of hyperacusis be differentiated: first, definite lowering of the threshold of hearing, or increased acuity, which may be termed "oxyecoia;" second, an abnormal discomfort caused by sounds above a certain intensity, which may be termed "hyperaesthesia dolorosa." The second type is considered due to paralysis of the stapedius muscle and has been known to accompany paralysis of the facial nerve. In the case reported the condition was of the second group, and the discomfort experienced by the patient was from sounds of intensities sufficient to produce contractions of the stapedius muscle. Fatigue of the auditory mechanism was more marked in the affected ear and required a longer period of recovery. The study of this case corroborates the findings previously recorded on the action of the stapedius muscle and the part it plays in the function of hearing.

Kelley [7] made a study of 88 persons over 50 years of age to determine the auditory loss with increasing age and its effect on the perception of

6. Perlman, H. P.: Hyperacusis, Ann. Otol., Rhin. & Laryng. **47**:947 (Dec.) 1938.

7. Kelley, N. H.: A Study in Presbycusis: Auditory Loss with Increasing Age and Its Effect on the Perception of Music and Speech, Arch. Otolaryng. **29**:506 (March) 1939.

music and speech. He found the hearing for 1024 cycles practically normal up to 70 years of age. Between 70 and 80 there was a loss of 14 decibels. At 50 presbycusis is apparent for frequencies of 2048 and above, the loss increasing as the frequency becomes higher. Presbycusis increases for the high frequencies with advancing age. His study reveals that a person with decreasing sensitivity for the higher frequencies does not experience the same quality in a musical tone as one with normal hearing. An orchestral selection heard by a person with presbycusis does not contain the same richness it did when his hearing was normal for the high frequencies. The complex tones lack brilliance, and qualitative differences are not detected. A person over 60 has no difficulty in recognizing vowels except at a low intensity, such as 10 decibels above the threshold. However, his recognition of consonants is inferior at all intensities when compared with that of a person with normal hearing. At the preferred intensity for ordinary conversation for persons with normal hearing, 38 decibels, the presbycusic person recognizes 75 per cent of the consonants.

Ansberry [8] tested two groups of persons, a normal one and one having impaired hearing, to determine the amplification above the threshold of hearing which is necessary before the sound becomes unpleasantly loud. The threshold of unpleasantness was taken where the tone was tolerable but not pleasant and not at the point where it produced pain. For every frequency from 64 to 8192 cycles the difference between the threshold of acuity and that of unpleasantness was at least twice as much for the normal person as for the one with impaired hearing, with an average difference of 24.9 decibels for the normal group and 10.887 decibels for the group with impaired hearing. The range, therefore, of usable, enjoyable sounds for the person with subnormal hearing is greatly reduced. This is an important difficulty to be considered in the fitting of hearing aids. An amplifier which responds more rapidly at one frequency than at another may break through this narrow band of pleasant sounds at that point. If the user then decreases the over-all volume it may cause the entire loss of the weaker sounds of speech, since they may lie in bands to which he is less responsive.

Jones [9] points out the importance of the use of tests which measure the perception above the minimal threshold. Some patients actually hear better than their minimal threshold indicates. In 1922 Jones tested patients with a simple vacuum tube amplifier and found that those with conduction defects heard well but that those with marked perceptive

8. Ansberry, M.: Auditory Threshold of Unpleasantness in Normal and in Hard of Hearing Subjects, Arch. Otolaryng. **28**:954 (Dec.) 1938.

9. Jones, I. H.: The Attempt at Precision Measurements of the Ear, Laryngoscope **44**:505 (July) 1939.

impairments heard much better without amplification. This test can be applied today, a vacuum tube hearing aid being used as a diagnostic instrument. If the patient hears well with it, one knows that he has a conductive defect. This test is helpful in conjunction with the usual audiogram of the minimal threshold of hearing. It can be made under usual noisy conditions, and any vacuum tube amplifier can be used, but one that furnishes high quality amplification is preferable.

A sound-proof booth is necessary to detect beginning defects in hearing. The ideal opportunity for preventing deafness lies in the testing of school children. Nothing can compare with the systematic examination of all school children. If one uses the available tests for hearing, done properly in a sound-proof booth, even with their limitations, one will approach precision.

Bunch [10] reports a case of traumatic deafness following the explosion of a firecracker as further evidence of the relation between deafness and excessive stimulation by loud sounds. The reaction to the Rinne test was positive; hearing by bone conduction was somewhat decreased; perception in the Weber test was referred to the unaffected ear, and the loss of hearing for high tones was much greater than for low, the patient presenting a classic picture of primary perception or nerve deafness. Recovery took place in three days and was almost complete except for a marked dip at 4096 double vibrations, to approximately 45 decibels. Gaps of this nature, as pointed out before by Bunch, may result from excessive stimulation by industrial noises. They normally appear near 4096 double vibrations and are commonly found in the hearing records of hunters and sportsmen, who may be unaware of the condition and often have no loss in acuity of hearing for the spoken voice.

Selfridge [11] reports several cases in which deficiency of a vitamin was found associated with deafness for high tones. The patients showed variable improvements in hearing under vitamin therapy. He presents the problem to bring out the possibility of this factor being an additional cause for degeneration of the auditory apparatus.

Unger [12] utilizes the audiopupillary reflex in an objective test for hearing. This phenomenon was previously described by Cemach, Schurggin and others. This reflex is a quick consensual dilatation of the pupil followed by an equally quick contraction, which occurs when the ear perceives a loud noise. The contraction persists during the con-

10. Bunch, C. C.: Traumatic Deafness from the Explosion of a Fire Cracker, Ann. Otol., Rhin. & Laryng. **47**:1092 (Dec.) 1928.

11. Selfridge, G.: Eighth Nerve High Tone Deafness from a Nutritional Standpoint, Ann. Otol., Rhin. & Laryng. **48**:596 (Sept.) 1939.

12. Unger, M.: Objective Measurement of Hearing, Arch. Otolaryng. **29**:621 (April) 1939.

tinuance of the sound. Unger uses an audio beat frequency oscillator for his sound. Two ear phones are used, one for the patient and one for the physician. The dial is set for the frequency desired with the power off. The power is turned on slowly and the pupils watched carefully. When a quick dilatation is noted, the number of decibels is recorded. The test should be repeated several times to rule out accommodation.

To eliminate the possible confusion caused by the contraction of the pupil in accommodation, the patient wears a strong convex lens, of 40 diopters, which overcomes the ability to accommodate and also greatly enlarges the pupil. The examination may be tiring for both patient and examiner and may require two or more sessions. An accompanying graph shows the marked similarity of the two curves, that for subjective hearing and the other, in which the examiner noted the reflex. Unger feels that under proper conditions this test is remarkably accurate and that it is definitely useful in the detection of malingering. It should have a definite place in the examination of candidates for military service or victims of accidents when the question of impairment of hearing has to be considered. This appears to be a practical method for observing the pupillary reflex to sound.

The usual methods of testing the hearing consist of measurements of the threshold for various frequencies perceived by bone and by air conduction. The Weber test is mentioned as an exception; the Stenger test is not mentioned at all. De Maré [13] undertakes a series of carefully conducted experiments on the reaction of both normal and poor-hearing ears to tones of greater intensity than threshold under conditions of artificially induced fatigue, with masking and with the subjective sense of loudness. He starts by accepting as the most satisfactory theory of hearing the one which states that perception of sound is brought about by stimulation of the basilar membrane, different frequencies affecting different areas or bands of the membrane, intensity of perception depending on the number of neural elements involved. Patients with different types of deafness react differently under the handicaps mentioned. As a well known example he mentions paracusis Willisii; persons with obstructive deafness believe they hear better in a noise. Those with nerve deafness find that they hear much worse in noisy places. He believes that these tests may find valuable clinical diagnostic application and mentions E. P. Fowler's [14] recruitment of loudness test.

13. de Maré, G.: Audiometric Investigations of the Reaction of the Normal and Abnormal Ear Under Functional Handicap, Together with Observations on the Theories of Hearing, Acta oto-laryng., 1939, supp. 31, p. 1.

14. Fowler, E. P.: The Use of Threshold and Louder Sounds in Clinical Diagnosis and the Prescribing of Hearing Aids, Tr. Am. Otol. Soc. **28**:154, 1938.

With nerve deafness, with the threshold for a certain frequency higher in one ear than the other, when the intensity is increased sufficiently, it appears equally loud in both ears. He accepts this feature as characteristic of nerve deafness.

The author employed two audiometers and a rotary switch which automatically interrupted the tones. For the masking test, he used the interrupted tone of four-tenths second's duration at intervals of three and five-tenths seconds, masked by a continuous tone; for the fatigue, or adaptation, test, after exposure to a certain frequency he remeasured the threshold for that frequency. He also switched in a "fatiguing" tone in the intervals of the interrupted tone and measured in decibels the amount necessary to blot out the interrupted tone. The results are statistically presented. The fatigue appears not to depend either on psychic influences or on the musculature but rather corresponds to the process of adaptation of the hearing receptors. The pathologic material was taken from cases of pure conduction deafness, of pure nerve deafness and of mixed types. In patients with conduction deafness the effect of fatigue was less marked than in normal persons and was approximately in proportion to the degree of deafness. In patients with nerve deafness it was equal to or more marked than that in normal persons; i. e., the former were more easily fatigued. The author suggests the possibility of this test serving to diagnose even different types of damage to the perceptive apparatus. The masking effect is less in patients with all types of deafness than in normal persons. It leaves unexplained why patients with nerve deafness hear less in a noise than those with conduction deafness. Perhaps this is due to a different irritation curve in the basilar membrane in the two conditions.

There is a complete review of the literature citing a number of American references unusual on the part of a European investigator. The monograph represents a painstaking investigation in a relatively new field of functional testing.

Crowe [15] states that the only way to make a satisfactory differential diagnosis of deafness is to take a detailed history, to examine the upper air passages, the tympanic membranes and the eustachian tubes and to use masking when making the hearing tests. The audiometer test must always be supplemented with fork tests. It is essential when one is interpreting an audiometer chart to know that the hearing for the high frequencies becomes more and more impaired with each decade. The three conditions in the middle ear which impair hearing are partial or total obstruction of the eustachian tube, any lesion that interferes

15. Crowe, S. J.: Diagnosis and Differential Diagnosis of Deafness, Arch. Otolaryng. **28**:663 (Nov.) 1938.

with the movement of the ossicles and fixation of the footplate of the stapes due to otosclerosis. It is important to know that during the early stages of obstruction of the eustachian tube in children the hearing is more impaired for high than for low tones. If this condition is not recognized and properly treated in its incipiency, the impairment of hearing progresses from one octave to another toward the low end of the scale. When the hearing for tones between 2000 and 4000 double vibrations becomes involved, the patient begins to be noticeably deaf. This may take ten years or more, and when it does occur the damage to the middle ear is often permanent. To diagnose overgrowth of lymphoid tissue around the orifice of the eustachian tube, examination with the nasopharyngoscope with some form of anesthesia is essential. Correlation of the results of functional tests with those of histologic studies shows that any lesion interfering with the movement of the ossicles causes marked loss of hearing. When the movement of the malleus and the incus is impaired, the loss of hearing usually begins with the higher frequencies, whereas with involvement of the stapes alone perception of the low as well as of the high tones is impaired.

Crowe gives several illustrations of conditions in which early stages of involvement of the inner ear or of the cochlear nerve may cause selective loss of hearing for high tones. A study made several years ago brought out two points of practical importance. When the middle ear and the eustachian tube are normal and the impairment of hearing begins at 256 or 512 double vibrations and increases gradually with each octave toward the high end of the scale, the lesion is atrophy of the cochlear nerve supplying the basal turn of the cochlea. The organ of Corti is not affected. When under the same conditions the audiogram shows abrupt or sharply localized impairment of hearing for the high tones, both the nerve and the organ of Corti are atrophic.

Crowe and Baylor [16] present some of the preliminary conclusions from their studies of over 15,000 records of hearing tests covering fourteen years. The study was to correlate impaired function as determined by clinical tests with the location and nature of the causal lesion. They found that long-continued partial obstruction of the eustachian tubes in children causes retraction of the tympanic membranes, impaired hearing for high tones with relatively good hearing for the low tones and sometimes total loss of hearing by bone conduction. This revolutionary statement is based on a study of 60 children over ten years. In all the cases the pharyngeal orifices of the eustachian tubes were partially occluded with nodules of lymphoid tissue. The

16. Crowe, S. J., and Baylor, J. W.: The Prevention of Deafness, J. A. M. A. **112**:585 (Feb. 18) 1939.

earliest symptom of such partial obstruction is impaired hearing for tones between 10,000 and 16,000 double vibrations. If untreated, the deafness progresses, involving one octave after another toward the low end of the scale, and becomes evident when the speech range becomes affected. If the causal condition is properly treated before the age of 15, hearing usually returns to somewhere near the usual level. After this age, the results are far less satisfactory, and secondary changes in the middle ear may be so advanced that they can be repaired by no treatment whatever. The most satisfactory method of treatment is irradiation with radium or roentgen rays. This may not permanently remove hyperplastic lymphoid tissue, but relatively small doses keep it in abeyance during the age in which it grows most actively. They stress the importance of nasopharyngoscopic examination in such cases for both diagnosis and, if necessary, treatment, general anesthesia being used if required for the examination. They feel that if school children in the primary grades were examined with the nasopharyngoscope at least once a year and those with hyperplastic lymphoid tissue in and around the orifice of the eustachian tubes were treated with radiation as often as necessary to insure normal function of the tubes, the number of deaf adults in the next generation could be reduced by 50 per cent.

Crowe [17] presents his views on progressive deafness in another article also. He emphasizes the following points which must be accepted or proved before one can recognize and intelligently treat this type of deafness. Impaired hearing for the higher frequencies with good hearing for low tones does not always indicate an irreparable lesion of the inner ear or the nerve. A long-continued obstruction of the eustachian tubes may produce marked shortening or total loss of hearing by bone conduction for the 512 double vibration fork, and the hearing can often be restored to normal.

Retraction of Shrapnell's membrane in a child with an otherwise normal-appearing drum is a danger signal of impending loss of hearing and warrants a search for the cause, which may be partial closure of the eustachian tube. All lymphoid tissue is not necessarily removed when the tonsils and adenoids are removed. Nodules of lymphoid tissue may appear in the pharynx after operation. This condition may not be recognized when it occurs around the orifices of the eustachian tubes unless a nasopharyngoscope is used for examination. In order to safeguard the hearing, it is advisable to make such an examination once or twice a year until puberty.

17. Crowe, S. J.: The Prevention of Deafness in Children, Laryngoscope **49**:591 (July) 1939.

Pohlman [18] brings out the point that it was unfortunate that Crowe and his workers reported only on the sensitivity by bone conduction to a 512 double vibration tuning fork. The writer presents 2 cases of adults showing a similar curious limitation in the conduction of sounds of high frequency, with a negative reaction to the Rinne test for these sounds, in whom the eustachian tubes were patent. In 1 the condition was quite definitely due to changes at the footplate of the stapes. Study of these cases indicates that the peculiar findings may result from conditions other than blocking of the eustachian tube. It also emphasizes the importance of an audiometric examination throughout the frequency range for both air and bone conduction before a definite diagnosis of a mixed deafness may be made.

Bunch [19] attempts to answer some of the questions pertaining to the progress of deafness in otosclerosis. A series of patients was tested and observed over six years. Although this period covers only a small part of a lifetime, it is significant that the evidence obtained does not reveal an average measurable increase in the loss of hearing during this time. When the deafness had increased an obvious factor was not found to account for it. Changes, either improvements or regressions, were often unilateral and varied in different frequencies. Time alone is not the factor determining the progress of the deafness. Bunch noted that when the patients were fatigued they exerted additional physical and nervous energy to understand conversation. As a result they eventually ceased to listen and gave the impression of a greater loss of hearing than actually existed. Six women were observed who had borne children during the period. Tests were made before and after childbirth and also at a later date. None of the subjects showed any definite increase in deafness associated with childbearing.

Lüscher [20] states that audiometric examinations have shown that the rule that interference with the conduction apparatus affects primarily or exclusively the hearing for low tones and that disturbance of the perception apparatus affects that for high tones no longer holds. As a matter of fact, he says, there is still lack of clarity in correlating the curves of audiograms to the location and type of aural involvement, and only rarely is it possible to draw unquestionable conclusions regarding the exact nature of the aural impairment. He quotes the work of Crowe

18. Pohlman, A. G.: A Note on the Greater Disability for Hearing High Tones in Cases of Conduction Deafness, Ann. Otol., Rhin. & Laryng. **48**:596 (Sept.) 1939.

19. Bunch, C. C.: The Progress of Deafness in Clinical Otosclerosis, Laryngoscope **49**:793 (Sept.) 1939.

20. Lüscher, E.: Investigation of the Influence on Hearing Ability of Strain on the Ear Drum, Acta oto-laryng. **27**:250, 1939.

and Guild, who demonstrated marked loss of hearing for high tones in some cases of stenosis of the eustachian tube.

The determinations of the thresholds of hearing were made with the oto-audion designed by Kraft. Then Lüscher produced disturbance of the conduction apparatus by employing four methods of weighting the tympanic membrane:

1. "Point" loading of the umbo with increasing weights.

2. Loading of the pars tensa with drops of mercury of various weights.

3. Loading of the pars tensa with drops of water of varying weights.

4. Filling the external auditory canal with water.

The ear not under examination was plugged with "oropax" [composition not stated]. The tests were made with the patient lying down and with the tested ear about 20 cm. from the loud speaker. In each instance a careful audiometric examination was made before the various methods of loading were carried out. After this in most cases the ear was again checked unweighted. The preliminary and the final curves showed a maximum variation of only 2.5 degrees on the audiometer curve.

The conclusions are as follows: 1. "Point" loading of the umbo to the extent of 3.66 and 6.66 Gm. (by means of a rod with a small sphere on the lower end and a plate on the upper end on which weights were placed) produced strikingly small disturbances of hearing, with loss for the lower and middle ranges but preservation of the upper tone limits. 2. Loading of the pars tensa with drops of mercury to the extent of 0.5 to 2.0 Gm. gave light to marked impairment of hearing with lessening for all tones but most marked loss for the middle to the high range and lowering of the upper tone limit. 3. Loading with drops of water, 0.05 to 0.25 Gm., produced changes qualitatively similar to those produced with mercury but of less degree. 4. Filling the external auditory canal with water caused marked impairment of hearing similar to that produced by loading with mercury. 5. The classic dictum that loss of hearing for the lower range is most marked applies in only a portion of cases of involvement of the middle ear. Judging from the clinical audiograms, there are several types of disturbance of hearing in the middle ear, of which a portion show involvement mainly for the tones from the middle range to the upper limit.

Fifteen years ago Sonnenschein [21] reviewed the extensive article by Runge on the "water filling test." This splendid monograph dis-

21. Sonnenschein, R.: The Functional Examination of Hearing: Annual Summary on the Problems of the Deaf, Papers Relating to Deaf-Mutism and Education of Deaf Children, Mechanical Devices for Hearing, Lip Reading, and So Forth. Arch. Otolaryng. **1**:89 (Jan.) 1925.

cussed many phases of bone conduction. Runge found in a series of cases of otosclerosis no lengthening of perception by bone conduction when the water filling test was used, but when the otosclerosis was light and the hearing for the whispered voice still good slight prolongation was noted.

> In cases of cochlear degeneration the bone conduction, which had been greatly reduced, was usually doubled in length by the water-filling tests. In the early and in the final stages of acute otitis media, the bone conduction is diminished with the test as compared with a normal ear; in well developed acute otitis the bone conduction is not increased by the water filling.
>
> . . . [Runge] also believes that the increased bone conduction normally present when the ear is filled with water is due to two things, namely: (1) A better transmission of sound to the drum membrane by the fluid, (2) to a diminished "outflow" or escape of sound from the ear; it seems the former is the more important factor.

Macfarlan [22] traces the history and development of audiometry. He mentions the first devices capable of producing sounds of controlled intensity. The advent of simple electric circuits produced the buzzer type of audiometer. The noises were an unknown mixture of frequencies, testing with which gave no data on the hearing in various parts of the auditory range. In 1903 Dr. Sohier-Bryant presented a phonograph audiometer for testing speech, and several years later the "audiophone" was introduced, which was a phonograph with an electric pick-up with speech sent through a telephone receiver. In 1920 Carl Seashore introduced the use of special records to determine such factors as the appreciation of pitch, intensity, interval and consonance. The next development in phonographic audiometry was the 4-A audiometer of the Western Electric Company. Mechanical equipment is now becoming better and the methods of testing are constantly being improved with the more thorough scientific knowledge of speech and of the hearing of speech.

In 1921 Dr. John Guttman introduced and described an electric acoumeter which was the first instrument to use vacuum tubes for testing hearing. The first frequency run audiometer developed especially for testing hearing was the Bell Laboratories' eight octave audiometer known as 2-A. Harvey Fletcher introduced this in his article in 1925 and introduced also the new unit of intensity, the decibel. Macfarlan gives a list of the audiometers now actively on the market and also names the oscillators adaptable for use in testing hearing. Progress has been made also toward the standardization of these instruments. Macfarlan concludes his paper by listing the names of Americans and other otologists who have made contributions to the development of audiometry.

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22. Macfarlan, D.: History of Audiometry, Arch. Otolaryng. **29**:513 (March) 1939.

The Council on Physical Therapy of the American Medical Association [23] published the following requirements for acceptable audiometers: Audiometers shall be equipped for testing both bone and air conduction; they shall have fixed or continuous frequencies from 128 to 8192 cycles; the frequency of each tone shall remain within plus or minus 5 per cent of the designated value; calibration shall be in decibels, with 5 decibels per step or less; requirements for purity of tone shall be met; extraneous noises shall be at least 60 decibels below the level of the test tone for frequencies of 1024 cycles and higher and at least 40 decibels below the level of the test tone for frequencies below 1024 cycles; the bone conduction receiver shall not produce sound in the air so that it could influence the validity of the measurement of bone conduction, and the audiogram blank shall use the same base line for the results of both air conduction and bone conduction.

Newhart [24] reports on a new pure tone audiometer especially designed for individually testing the hearing of large groups, particularly school children. This is known as the Maico D-6 school audiometer. The special features of this instrument are its low cost, uniform zero reference lever and illuminated, easily read intensity and frequency dials.

Its operating range is from 128 to 8192 cycles at fixed intervals at one octave with intensities variable in steps of 5 decibels. Thirty to 50 persons per hour, or 150 to 250 per school day, can be tested. This instrument is not intended for diagnostic purposes, as it does not include means for bone conduction tests or masking.

In view of the researches being pursued at McGill University it was found necessary to improve the audiometric methods used at the Montreal General Hospital.[25] With precise measuring instruments, it was found, the recorded results could still be largely affected by the method of application of the stimulus, the reliability of the subject's response, the control by the technician and the recording of observations. To overcome the objections to the usual ear phone, the patient is placed in a thoroughly sound-proof room, in an open sound field produced at a convenient distance from a loud speaker. To obtain reliable responses from the subject, a technic is used involving successive trials by stimuli selected at random in the neighborhood of the threshold. A machine is used called the random stimulus selector, which selects at random one of six intensities chosen or the zero intensity and presents this to the patient, lighting a lamp to inform the patient that the test is proceeding. A switch

23. Minimum Requirements for Accepted Audiometers, report of the Council on Physical Therapy, J. A. M. A. **112**:732 (Feb. 25) 1939.

24. Newhart, H.: A New Pure Tone Audiometer for School Use, Arch. Otolaryng. **25**:777 (Nov.) 1938.

25. Barr, E. G., and Mortimer, H.: Improvements in Audiometry at the Montreal General Hospital, Canad. M. A. J. **40**:22 (Jan.) 1939.

provides the choice of either a 20 decibel or a 10 decibel range to be covered by the six intensities. It counts the number of trials of each intensity and locks each out of use when the stated number of trials of the intensity is completed. This can be adjusted at from one to ten trials, but five trials are generally used for each of the six intensities at each frequency. To control the recording of operations, electric solenoid operating mechanisms are provided for eight keys of a standard typewriter. When the patient presses a "no" button, a semicolon is typed, and when he presses a "yes" button an asterisk is typed if the zero stimulus is presented, or one of the letters "a," "s," "f," "g," "j," or "k" according to which of the six differing intensities was then presented to the patient. After the patient has pressed one or the other of the reply buttons, he is unable to alter the course of events, which is in the following sequence. The typing of the reply is immediately followed by deenergizing of the random stimulus selector. Everything is automatic except that the patient presses the button. The time of the test for five trials of each intensity varies with the quickness of the patient but generally is from four to five minutes. The range of indecision of new subjects is found to be as narrow as with skilled subjects. This type of installation is applicable also to other fields of investigation, such as comparison of the threshold with and without a hearing aid and comparisons of levels at which articulation is clear. Charts showing the recording of the tests and a complete description of the construction of the sound-proof room accompany the article.

In subjective tests it is doubtful whether the responses of a patient of questionable intelligence are as reliable as the observations of a trained investigator.

Newhart and Hartig [26] describe the construction of a practical, efficient, portable and inexpensive booth for testing hearing. It has a relatively high effectiveness in reducing noise and is most efficient in attenuating high-pitched sounds. The form of construction and the method of assembly are fully described and pictured.

Ciocco [27] presents the results of examinations of the hearing of 552 children who had been tested five years earlier. The results show particularly changes in acuity of perception by air conduction. The various degrees of impairment of hearing were defined as follows: Good hearing was present when the tones tested, namely, 64 to 8192 double vibrations, were heard at 20 decibels or less. Slight loss for tones of the speech range was present when one or more tones of the low or middle range, up to 1024 double vibrations, was heard only at 20 to 35

26. Newhart, H., and Hartig, H. E.: An Efficient and Practical Booth for Testing Hearing, Arch. Otolaryng. **28**:1000 (Dec.) 1938.

27. Ciocco, A.: Audiometric Studies on School Children, Ann. Otol., Rhin. & Laryng. **47**:926 (Dec.) 1938.

decibels, and hearing for the upper range was within normal limits. Marked loss for tones of the speech range was present when the low range was heard only at 35 decibels or above while the higher tones were heard at any intensity. Slight loss for high tones was diagnosed when tones ranging from 2048 to 8192 double vibrations could be heard at 20 to 35 decibels, and the remaining tones at frequencies equal to or less than 20 decibels; marked loss for high tones was present when the upper tones were heard only at or above 35 decibels.

This investigation revealed that the frequency of loss for high tones had increased by about 300 per cent in the group, whereas impairment for tones in the speech range had increased only by about 20 to 30 per cent. About one fourth of those who previously had had slight impairment were worse but remained with the same type of impairment. When marked impairment had been found five years before, a similar condition still existed in the majority in this group. The development of impairment of perception for tones of the low and middle ranges does not seem to be related either to the sex of the child or to the age at the first examination. However, the number of children in whom slight loss of hearing for high tones developed increased concurrently with the age of the children at the first examination. The percentage of the children in whom loss of hearing for high tones developed increased with age up to 10 years and decreased thereafter. The percentage of boys who acquired marked loss of hearing for high tones during the interval was three times that of the girls. The other forms of auditory defects developed with equal frequency in the two sexes.

Hughson, Ciocco and Palmer[28] made careful audiometric studies of 460 profoundly deafened children of the Pennsylvania School for the Deaf, to provide data for future pedagogic and possible therapeutic effort. They found that the great majority of these children had a bilateral defect approximately the same in the two ears. Complete lack of response to auditory stimulation is rare. Ninety-five per cent of the group responded to at least one tonal frequency by air conduction in one ear and 85 per cent in both ears. The percentage of children who became deaf after birth was highest at 1 year of age and decreased rapidly at each successive year. Fifty-four per cent were born deaf. The acuity of hearing was essentially the same for both those born deaf and those who acquired the loss in early infancy and childhood. The important causative factors for the acquired deafness were meningitis, trauma to the head, measles, otitis media and scarlet fever. These comprised the cause in 50 per cent of the cases, of which meningitis alone produced the condition in 17 per cent. There is apparently no association between

28. Hughson, W.; Ciocco, A., and Palmer, C.: Studies of Pupils of the Pennsylvania School for the Deaf, Arch. Otolaryng. **29**:403 (March) 1939.

auditory thresholds and the stated cause of deafness. A significant number of the children were found to have enough residual hearing by either air or bone conduction to warrant some rational effort toward therapeutic relief.

Fry and Kerridge [29] present the tests for hearing of speech by deaf people. These are used at the hearing aid clinic at the University College Hospital, London. Although they realize that speech tests are not accurate, nevertheless they feel that there are times when some sort of voice test with a detailed measurable result is helpful, as when deciding between possible settings of a tone control on a valve amplifier hearing aid. It has been found that the important requirements for a good test for deaf people is a simple short test which takes into consideration how frequently sounds occur, as well as their variety, and a speaker with a familiar voice. Two types of test are used: lists of monosyllabic nouns and short commonplace sentences. The former is used for people who understand isolated but common words; the latter, for those who require help from the context to comprehend the meaning. The nouns are grouped in five columns of twenty-five words and the sentences in five series of twenty-five each. One series is used on any one occasion of testing. The room is relatively quiet, with noise not more than 30 phons. The speaker should be some one with whose voice the deaf person is familiar, as a member of his family. The distance should be 4 to 16 feet (122 to 488 cm.), depending on the deafness of the patient. This distance is in accordance with private conversations or general conversations. The patient's eyes should be closed to avoid lip reading. Four marks are allotted to each word or sentence. In the sentence a wrong word constitutes one mistake. In the word test, one mistake consists of an error in initial, vowel or final sound, and one mark is deducted for every fault. Any person whose total score is less than 35 per cent on the word test should be retested with the sentences.

Harms and Malone [30] present data to show that stammering is rare in those with total loss of hearing. They show, however, that loss of acuity of hearing during the period of formation of speech may be a cause of stammering in persons who are unaware of any loss of hearing. All showed loss of hearing varying from 10 per cent to 22 per cent. This strongly suggests the relation between loss of hearing and the development of stammering. Hearing aids should be used in correction of speech which cannot be improved to a useful level by other therapy.

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29. Fry, D. B., and Kerridge, P. M. T.: Tests for the Hearing of Speech by Deaf People, Lancet **1**:106 (Jan. 14) 1939.

30. Harms, M. A., and Malone, J. Y.: Hearing Acuity and Stammering, Ann. Otol., Rhin. & Laryng. **48**:596 (Sept.) 1939.

Goldstein [31] stresses the importance of residual hearing in the education of the hard of hearing child. He states that about 30 per cent of all congenitally deaf children have some residual hearing. In considering congenital deafness, Goldstein mentions several types of deafness and aphasia which have to be considered in making a diagnosis. The so-called "word deafness" is a condition in which the child may hear what is being said but is unable to analyze and interpret the sounds heard. Such children when properly trained frequently make such progress as to be able to carry on later in the normal classroom. Another condition to be considered is "congenital aphasia" or the mechanical inability to produce speech. Children with this condition may have normal hearing and may be incorrectly classified as congenitally deaf. Congenital "word deafness" (inability to understand and to use the spoken voice) may be present with normal hearing. Differentiation between a child having an involvement of the cortical speech areas and a congenitally deaf child may be difficult.

Various tests are employed in the diagnosis of congenital deafness. There are but few tests that can be accurately applied to a child under 2 or 3 years of age. The voice test for children of this age should be ruled out, as they have not acquired sufficient knowledge of speech to insure correct response to questions. In a normal child some change in the position of the head, usually toward the source of the sound, is usually elicited when some familiar sound is made close to the ear. Such sounds as stamping of the feet, shrill whistles and claps of thunder are not regarded as providing an adequate test by the writer. High-pitched forks or Galton whistles are of no avail when nerve deafness is present, and low-pitched forks may elicit a tactile response rather than that of hearing. The palpebral reflex test is of questionable reliability.

Important information can be obtained from the labyrinthine tests.

> Whenever a young child (aged one to four years), profoundly deaf, is found to have a normal nystagmus reaction or even nystagmus of reduced duration, the assumption is justified that the acoustic labyrinth is not entirely without function. . . . This type of patient, then, whether deafness is congenital or acquired in etiology, must be assigned to special training in speech and lip-reading.

The audiometer offers an additional means of determining residual hearing. When a congenitally deaf child does not respond to tones within the range of 300 to 3000 double vibrations when tested with a high-powered audiometer intensified to over 100 decibels, he must be considered profoundly deaf, with scant hope of reeducation or restimulation.

The presence of residual hearing can be determined also with the voice at close range. When residual hearing is found, training should

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31. Goldstein, M. A.: The Education of the Deaf and Hard of Hearing Child, Am. J. Surg. **42**:151 (Oct.) 1938.

be employed by what is generally termed the acoustic method. This method is defined by Goldstein as "stimulation or education of the hearing mechanism and its associated sense organs by sound vibration as applied either by voice or any sonorous instrument."

There are two types of acquired deafness: one which occurs before speech has been acquired and a second which occurs after fluency of speech has been established. A patient with the first type requires the same pedagogic training as the congenitally deaf child. In the second type lip reading and the preservation of speech are essential parts of the education. The question of the rehabilitation of the hard of hearing child is so important that some means must be found to supply adequate training for those with this type of physical handicap.

Keen [32] presents his observations on the relation between tests by the voice, the gramophone audiometer and the pure tone audiometer. Twenty-two audiograms were available from pupils of a special school for the deaf. Keen cautions one to be sure to check the output of the gramophone audiometer and determine whether it actually is the same as the decibel readings given on the machine. He also stresses the point that the two zero conceptions, of the gramophone audiometer and of the pure tone audiometer, do not correspond. One test involves the understanding and writing down of numerals, while the other is simply the hearing of a pure musical note, a process of perception which is comparatively easy for the ear and brain centers. As a whole, he finds that the correlation between the results is clear and appears rather accurate when one takes into consideration the widely different nature of the three methods of testing the hearing. Several factors may help to explain discrepancies between the different tests. A period of several months elapsed between the application of the three methods, and differences in the physical state of the child, as well as in the ears, may account for some of the discrepancies.

The results of the gramophone audiometer test were considerably higher than those of the voice tests. This may be due to a miscalculation in determining the comparative levels of loudness on the scale of the gramophone. More likely it is due to a mechanically reproduced voice of particular clarity remaining close to the ear being perceived more easily than the voice of a person gradually moving away from the ear. In addition, the repetition of the numbers given on the gramophone may aid in their reaching the brain centers after a while, for, on the whole, the gramophone audiometer test requires a smaller effort of concentration than the voice test.

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32. Keen, J. A.: Some Observations on the Relation Between Tests by the Voice, Gramophone Audiometer and Pure Tone Audiometer, J. Laryng. & Otol. **53**:581 (Sept.) 1938.

Newhart and Hartig [33] in discussing hearing aids bring out the necessity for otologists to have an elementary knowledge of the construction, performance and limitations of these instruments in order to render the best service to their patients. Three indispensable elements in the normal process of communicating ideas by speech have to be considered. These are the speaker, the listener and the path of sound transmission. Each element must function properly for a high degree of understandability. Enunciation must be clear and loud, the listener's hearing must be normal and the path of sound transmission must be free from echoes, reverberation, interfering noises or distortion. To offset the insufficient intensity of sound, amplification must be resorted to. External distortion of speech must be taken into consideration, namely, that kind which has the property of subtracting from the normal speech sounds, such as impairment of hearing, and that which adds noise components, such as is introduced by electrical hearing aids of the carbon microphone type.

Invaluable information is obtained from an audiogram for both air and bone conduction. Similar information may be obtained with the tuning forks, but less accurately. The audiogram indicates whether an air or bone conduction receiver should be used, the degree of amplification required at the different frequencies and whether the deficiency is such as will enable the person to wear either a carbon aid or a vacuum tube amplifier. Persons whose loss of hearing is moderate and fairly uniform through the speech range can be easily fitted with a carbon microphone aid, whereas those with a severe loss, especially for the higher frequencies, present a more difficult problem. Improvements in the range and the quality of the performance of hearing aids, the development of selective amplification and the perfection of wearable vacuum tube instruments have greatly increased the field of application of electric hearing devices. The otologist should be well equipped with an instrumentarium and with technical knowledge in order to show the patient that he is better prepared to serve him than is the high pressure salesman. He should protect his patient by giving him the benefit of aid in choosing a hearing device from the accepted models and should help him in deciding which is most suitable for him. Otologists should also encourage the makers of high grade hearing aids to submit their products to the Council on Physical Therapy of the American Medical Association for acceptance.

Aubry and Giraud [34] present a comparison of relative and absolute bone conduction curves. The membrana tympani vibrates with fre-

33. Newhart, H., and Hartig, H. E.: Hearing Aids, Arch. Otolaryng. **29**:614 (April) 1939.

34. Aubry, M., and Giraud, J. C.: Study of Bone Conduction for Diagnosis and Prognosis, Presse méd. **47**:653 (April 29) 1939.

quencies up to 1024. Above that frequency the vibrations go directly through the bone to the cochlea, and perception of them is affected only by blocking of the round window.

Reboul [35] states that at frequencies under 700 double vibrations the basilar membrane swings as a whole; therefore, for those frequencies it cannot act as a resonator, and they must be centrally differentiated. Above that pitch some bands of frequencies permit peripheral analysis. The differential between the perilymph and endolymph, influenced by vibrations, may explain the Wever-Bray phenomenon.

Arapova and Gersuni [36] state that the alternating current causes a sensation of sound in the normal ear. With inner ear deafness this is diminished; with conduction deafness it remains unaltered.

Nussdorfer [37] asserts that loss of hearing for tones from 4096 cycles upward begins even in the second and third decade, both by bone and by air conduction. There is some loss by both bone and air conduction throughout the entire range. A relatively small loss is present at the lower frequencies. There is abnormal fatigability.

Using high and low tones to test fatigability, Navyazhskiy [38] found that high tones induce greater fatigue. He believes it is a central effect. When both high and low tones are used there is less fatigue. The author believes the low tone masks the high one and so prevents central fatigue.

25 East Washington Street.

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35. Reboul, J. A.: Remarks on the Theory of Hearing, Rev. de laryng. **60**:144 (Feb.) 1939.

36. Arapova, A., and Gersuni: Electric Reaction of the Hearing Organ in Various Conditions, Fiziol. zhur. **25**:430, 1938.

37. Nussdorfer, R.: Audiogram of Senile Deafness, Atti clin. otol. Torino, 1938, p. 43.

38. Navyazhskiy, G. L.: Fatigue of the Ear and Masking, Fiziol. zhur. **25**: 353, 1938.

Abstracts from Current Literature

Ear

WHAT IS PERCEPTION DEAFNESS FROM A PHYSIOLOGICAL AND HISTOLOGICAL BASIS? M. H. LURIE, Ann. Otol., Rhin. & Otol. **48**:3 (March) 1939.

The author points out that hearing is a process which concerns more than the ear alone; it is the interpretation by the brain of the various impulses sent to it by the organ of Corti. Perception of sound is the same in all mammals, but interpretation depends on mental capacity. Deafness may be divided into (1) the inability of sound to reach the end organ (conduction deafness) and (2) the inability of the end organ or brain to receive or interpret the sound waves (perception deafness). The first is mechanical rather than true deafness.

In discussing the function of Corti's organ, the author states that the tectorial membrane should be regarded as a modified otolithic structure, its function being similar to that of the otolithic membrane of the vestibular apparatus, aiding in the movement of the hairs of the external and internal hair cells. He does not agree with Wittmaack's claim that these hair are artefacts. The tectorial membrane is in intimate contact with the organ of Corti.

The stria vascularis is similar to the choroid plexus of the brain, and the endolymph is secreted by it. The author questions whether changes in the stria will cause deafness, as many animals with normal hearing showed changes in this structure.

It has been maintained that vibration of the basilar membrane on which Corti's organ rests is not necessary for hearing. Lurie cites his experiments showing that the basilar membrane can be made to vibrate sufficiently to throw off the organ of Corti with a resulting loss of response from that region. The organ of Corti rests only partially on this membrane, the external hair cells and external pilar cells resting on it while the internal hair and pilar cells rest on bone, thus allowing greater movement of the external than of the internal cells. The internal pilar cell has a sort of hinge socket for the head of the external cell. Because of this arrangement of the internal and external hair cells it appears likely that the external cells are affected before the internal. The author cites experiments on guinea pigs in which they were exposed to an interrupted tone of 2,500 cycles at high intensity for a long time and showed a loss of 10 to 40 decibels according to the number of external hair cells destroyed, a loss of hearing similar to boilermakers' deafness. The animals were not totally deaf but lost only part of the hearing, the internal hair cells responding to sounds, but at higher intensities. These experiments indicate a difference in function between the internal and the external cells, the external cells responding to weaker and the internal to more intense stimuli. Animals made deaf by quinine showed similar degeneration of the external hair cells, indicating that these cells are not only more sensitive but also more liable to degeneration from trauma or toxins than the internal.

Perception deafness can be considered a degeneration of the external hair cells of the organ of Corti. Lurie points out that a single nerve fiber supplies a large number of external hair cells, while only one or two of the internal cells are supplied by a single fiber. The external cells pick up sounds of small intensity, as with a multiple nerve supply they detect slight changes more easily; also there is no fine discrimination of pitch in the external cells. The single nerve supply

of the inner hair cells points to a more accurate determination of pitch, since a difference could be picked up two hair cells apart. With the external cells this difference would be many cells apart.

The organ of Corti can remain functioning for a long time after section of the nerve to the cochlea, and this may explain the recovery of hearing in cases in which there has been complete deafness during the course of a disease. When the neuritis disappears or the nerve regenerates, normal connections between the brain and the end organ are again established. M. V. MILLER, Philadelphia.

AN OPERATION FOR POSSIBLE ALLEVIATION OF CERTAIN CASES OF CONGENITAL DEAFNESS AND CERTAIN TYPES OF ACQUIRED CHRONIC DEAFNESS. EARL C. PADGETT, Ann. Otol., Rhin. & Laryng. **48**:113 (March) 1939.

The author points out that in spite of anomalies of the external ear, even in cases of congenital atresia of the external canal, there may be at least some partially functioning middle ear. One should be as sure as he can that there is a functioning auditory apparatus before operation is advised for building an external auditory canal. If there is a deformity of the auricle, especially with meatal atresia, the motion of the soft palate should be tested. When the deformity is unilateral and both palate arches move symmetrically, it shows a possibility of both eustachian tubes and middle ears being in fairly normal condition. If faulty motion is noted on the involved side there is probable impairment of the tube and tympanum on that side. Malformation of the middle ear is often associated with poor development of the muscles of the palate and eustachian tube. Needle puncture of the closed canal will show whether atresia is due to a fibrous, membranous or bony tissue. Stereoptic roentgenograms may help. The Weber test is helpful for intelligent patients.

The unsatisfactory results of intrameatal operations were pointed out and also the dangers of attempting to enlarge the bony canal, largely because with congenital malformations the facial nerve may be in an unusual position and may be injured. Padgett advocates a two stage operation to develop a new external canal posterior to the normal position, running through the mastoid process. A flap of skin is elevated from the mastoid, and the skin for the new canal is made from this after the canal is made through the bone. This may be allowed to open behind the ear or may be implanted into the cavum conchae, the latter at the second operation. He reports that Dr. O. Jason Dixon has done the operation in 15 cases.

M. V. MILLER, Philadelphia.

LATE EAR HEMORRHAGE FOLLOWING SKULL FRACTURES. W. E. GROVE, Ann. Otol., Rhin. & Laryng. **48**:120 (March) 1939.

Bleeding from the ear after injuries to the head is almost pathognomonic of fracture of the temporal bone, usually longitudinally through the petrosa. Most authors agree with this and also that the drum is torn only when the fracture reaches its margin. The sources of bleeding from the ear in injuries to the head are fractures of the external canal and injury to the tympanic plexus, the sigmoid sinus, the jugular bulb, the middle meningeal artery and, rarely, the internal carotid artery. When bleeding is especially free it is likely to arise from one of the peripheral sinuses. When from the internal carotid artery, it is cataclysmic and usually occurs from the ear, nose and throat at the same time.

If the fracture does not reach the margin of the drum but opens into the middle ear, blood will fill the latter and produce a bluish bulge of the drum. Hematotympanum may occur with both transverse and longitudinal fractures of the petrosa.

The author reports 7 cases of fracture with bleeding from the ears; in 4 bleeding occurred immediately and in 3 at varying times after the injury, but in all there were recurrences one or more times after complete cessation of the initial hemorrhage. He cites cases reported by others of delayed hemorrhages from the ear or into the labyrinth and also of late hemorrhage into the brain. He believes that these hemorrhages are analagous to intermittent epistaxis and intermittent cerebrospinal rhinorrhea after trauma. He states that in the cases of bleeding from the nose he has seen prodromal symptoms similar to those seen with bleeding from the ear: tinnitus, deafness, headache, mental depression and rise of blood pressure. He thinks that the increased blood pressure and intracranial pressure are responsible but feels that the true explanation of late aural hemorrhage will have to await material from autopsies.

M. V. Miller, Philadelphia.

The Clinical Significance and the Treatment of Otogenous Facial Paralysis. Hans Brunner, Laryngoscope **49**:276 (April) 1939.

After reviewing the clinical significance of otogenous paralysis of the facial nerve, Brunner again recommends his operation for patients in whom after one year spontaneous contraction does not develop and the electrical reaction does not show improvement.

Brunner's operation, performed endorally, aims to correct the condition only in the oral branch of the facial nerve, by sliding forward a flap of the masseter muscle beneath the mucous membrane and attaching it to the angle of the mouth. A short flap of the masseter muscle may be used, prolonged forward by catgut or a strip of fascia lata. The least risk is supposed to attend this method. Experience has shown not only that the implanted muscle flap assists mechanically but that nerve fibers grow into the paralyzed muscles from the implanted muscle, accelerating regeneration when it is possible and in all cases decreasing the disfigurement of the face.

Wood, Newark, N. J.

Otitis in Diabetes. E. H. Maier, Monatschr. f. Ohrenh. **73**:305 (May) 1939.

In discussing 35 cases of otitis media in diabetic persons treated at the Vienna Otologic Clinic, the author points out what possible relations between those two diseases might exist. The number of cases is 0.9 per cent of the cases of acute otitis media treated, but it cannot be determined whether the age of the patient has any influence, nor does it appear that the type of infection is of importance. Diabetes does not increase the number of operations nor complicate the after-treatment, but the author recommends local analgesia to avoid the danger of acidosis, which may complicate general anesthesia. If a patient does not respond properly to insulin therapy, such failure may be accepted as a measure of the intensity of the suppuration and an indication that the process is still progressing. The conclusions drawn by the author are as follows: When operation is indicated the diabetic condition is no contraindication, provided that proper internal medication has been given. If there is sufficient time, the patient should be rendered free of sugar and acetone. Difficulty in regulating the diabetic state of the patient is an indication for operation, as it reveals the progress of the suppuration. In every comatous state, a spinal tap is indicated to exclude meningitis.

Lederer, Chicago.

Roentgen Treatment of Acute Otitis Media. Palle Menck-Thygesen, Pract. oto-rhino-laryng. **2**:105 (April) 1939.

The author reports the results of roentgen therapy in the treatment of a series of 110 patients with acute otitis media. One hundred and seventy-two ears were involved.

His technic varied with the age of the patient. For those up to 2 years he used 100 roentgens with a filter of 4 mm. of aluminum; for those from 2 to 8 years, 150 r with a filter of 4 mm. of aluminum; for those from 8 years to early adult life, 200 r with a filter of 4 mm. of aluminum, and for adults, 200 r with a filter of 0.5 mm. of copper and 2 mm. of aluminum. Sixty-two of his patients required only one treatment; for 47 the treatment was repeated within eight days, and only 1 patient required three exposures. Paracentesis was done in all the cases, whenever indicated. In addition, the usual local treatment was instituted to maintain drainage and cleanliness.

The author made a comparison of a number of cases of patients treated with the ordinary routine and his group of patients treated by roentgen rays and found that in the latter 20 per cent of the patients were less likely to require operative intervention. In addition, the duration of the discharge was markedly decreased. The average length of discharge was eleven and three-tenths days. However, the latter fact was influenced by the time of institution of treatment, for he found that when treatment was started early after the onset of the infection, particularly in what he terms the presuppurative stage, his results were decidedly better. Untoward effects did not follow the treatment, and he disputes the development of such complications as falling of the hair, dermatitis or disturbance of hearing. In his series, 23 patients did not improve with treatment and had to be operated on.

In summarizing, he states that the treatment is painless, that the operative percentage is definitely lowered and that the duration of the discharge is shortened. The contraindications are fulminant progressive mastoiditis, extensive bony destruction of the mastoid cells as seen on roentgen examination or the onset of any intracranial complications.

PERSKY, Philadelphia.

TREATMENT OF TINNITUS AURIUM WITH HYPERTONIC SOLUTION OF MAGNESIUM SULFATE. D. IOANNOVICH, Pract. oto-rhino-laryng. **2**:114 (April) 1939.

In his discussion of tinnitus aurium, the author classifies its causes as either general or local. The general causes may be vasomotor, organovascular, contagious or toxic. The local causes, which may be intralabyrinthine or perilabyrinthine, may be dystrophic, inflammatory, neoplastic or degenerative. Tinnitus caused by vasomotor and vascular disturbances may be associated with headache and may be due to an increase in pressure in the perilymphatic spaces, usually the result of an increase of pressure in the posterior fossa.

In the latter group of cases, he injects intravenously 5 cc. of a 50 per cent solution of magnesium sulfate, slowly. The results of this type of therapy are rather striking, particularly for hypertonic persons.

His series of 50 cases is divided into the following groups: (1) cases in which evidences of circulatory vasomotor disturbance appeared without any apparent organic disease, in which group he obtained either improvement or cure in every case; (2) cases of arteriosclerosis; (3) cases in which the condition was associated with or followed frank disease of the middle ear; (4) cases of otosclerosis, in which group, of 6 cases reported, he showed improvement or cure in 4, and (5) cases of neurosis, in which group he had improvement or cure in 60 per cent of cases. Summarizing all groups, he found cure in 26 per cent and improvement in 40 per cent of cases, but, if he were to eliminate the group in which disturbances of conduction had occurred, then he would have had cure in 31 per cent and improvement in 48 per cent.

In conclusion, he recommends this technic as a harmless procedure but valuable in cases of tinnitus, particularly tinnitus due to vasomotor or vascular disturbances in or about the labyrinth. It was in this group that he obtained favorable results in 100 per cent of cases.

PERSKY, Philadelphia.

Pharynx

TUBERCULOSIS OF TONSILS. H. M. POLLARD and A. B. COOMBS, Am. Rev. Tuberc. **38**:746 (Dec.) 1938.

Among a carefully followed group of 107 children in whom tuberculosis of the tonsils was demonstrated active pulmonary tuberculosis developed during postoperative observation in 3, tuberculosis of the cervical lymph nodes in 1 and tuberculosis of the spine in 1. More complete examinations after the finding of tuberculous tonsils revealed that 9 of the children had had pulmonary tuberculosis and 3 tuberculosis of the mediastinal lymph nodes at the time of operation. Twenty children who had tuberculosis other than of the tonsils and adenoids at the time of operation did not subsequently acquire an additional lesion. Seventy patients with tuberculosis limited to the tonsils and adenoids remained free from tuberculosis or any other illness subsequently. It seems, therefore, that in patients in whom tuberculous infection is limited to the tonsils the disease rarely develops elsewhere. Careful postoperative examinations should be made of all patients with such local infection, however, and if evidence of disease is found elsewhere, the patients concerned should be kept under observation.

EUGENE H. SMITH, Ogden, Utah. [AM. J. DIS. CHILD.]

ROENTGEN TREATMENT OF THE TONSILS. BENASSI and M. SCARZELLA, Rev. franç. de pédiat. **14**:170, 1938.

Twenty-six cases are reported in which patients with diseased tonsils were given roentgen treatment in preference to tonsillectomy. In all, the tonsils became smaller and more normal in appearance, and the clinical improvement in the general condition compared favorably with that following tonsillectomy. The authors emphasize that roentgen treatment acts primarily on the infected, hypertrophied tissue and does not destroy the normal lymphatic tissue. They also state that the radiation stimulates the histiocytic response and so mobilizes forces combating infection. The details of the roentgen technic are given.

LESLIE, Evanston, Ill. [AM. J. DIS. CHILD.]

HEMORRHAGES AFTER TONSILLECTOMY. E. G. OSER, Monatschr. f. Ohrenh. **73**: 112 (Feb.) 1939.

The writer has observed among 12,241 tonsillectomies, 93 postoperative hemorrhages (0.75 per cent). A total of 3,121 operations were performed with the patient under local analgesia, with 65 postoperative hemorrhages (2 per cent), and 9,120 operations with the patient under general anesthesia were accompanied by 28 postoperative hemorrhages (0.3 per cent). Among 7,303 adenoidectomies he has observed but 3 postoperative hemorrhages. From these figures it follows that the danger of postoperative hemorrhages in general is greater in tonsillectomies performed under local analgesia than in those performed under general anesthesia. The author further states that this danger is generally greater in adults than in children and that, as far as the adenoidectomies are concerned, it is diminished to a great extent if the epipharynx is examined by palpation after the operation for remains of adenoid tissue.

LEDERER, Chicago.

Larynx

POSTURAL TREATMENT OF ACUTE LARYNGOTRACHEOBRONCHITIS. T. C. GALLOWAY, J. A. M. A. **112**:1566 (April 22) 1939.

Galloway discusses acute laryngotracheobronchitis in fair detail, stressing certain points in the differential diagnosis, as well as the pathologic processes of all of the structures, including the mechanical phases, the pathologic functions and the clinical features resulting therefrom. He quotes freely from the recognized authorities.

The cases of 10 patients in his service, 2 of whom died, constitute the central theme about which the discussion is woven.

He emphasizes the use of tracheotomy when indicated but enlarges on the postural treatment of acute laryngotracheobronchitis. The technic, cited from Morlock, is as follows: The foot of the bed is elevated at least 15 degrees and more if the patient will tolerate it. "In children the prone position with the foot of the bed raised provides a much better gradient and it is usually accepted easily." It is important that the fluid elements in the respiratory tree be of such consistency that they flow readily to the areas of greater cough reflex, where the tussive squeeze and cough may aid in the expulsion, postural drainage aiding not a little.

Lavage of the respiratory tract is moderately discussed. The author summarizes his therapy by outlining in full every means thus far known which he has used in his series of cases toward the attainment of best results for acute laryngotracheobronchitis.

GORDON, Philadelphia.

SUBGLOTTIC DIPHTHERIA, INITIATED BY SUDDEN ASPHYXIA, SIMULATING THE PRESENCE OF A FOREIGN BODY IN THE LOWER RESPIRATORY TRACT. C. RICCI, Arch. ital. di otol. **51**:157 (April) 1939.

Ricci reports the case of a child aged 14 months, apparently in perfect health, who, while eating supper, consisting of meat with fragments of cartilage and bone, suddenly became dyspneic, coughed violently and was cyanosed. Examination revealed almost complete immobility of the left lung without alteration in the voice or the cough. Direct laryngotracheoscopic examination revealed only slight congestion of the pharyngeal and laryngeal mucosa. Owing to the alarming condition of the child, immediate tracheotomy was done, after which the left lung immediately began to function and the cyanosis and distress were relieved. Respiratory difficulty recurred the following morning, together with profuse sweating, a rapid pulse rate, moderate cyanosis and rise of temperature. A roentgenogram revealed bronchopneumonia in the apex of the right lung. Death occurred seventeen hours after the onset. Autopsy revealed a diphtheritic membrane on the lower surface of the vocal cords and subglottic region, the presence of streptococci and Loeffler's bacilli and fatty degeneration of the liver, spleen and myocardium. The location of the diphtheritic membrane explains its oversight during the direct examination. It is assumed that the atelectasis was caused by toxic spasm of the left bronchus. Instances of diphtheria simulating a foreign body in the respiratory tract are rare; more common are cases of a foreign body simulating croup. The diagnosis in such cases is usually made late or at the autopsy table.

DENNIS, San Diego, Calif.

Nose

BEHAVIOR OF THE DIENCEPHALIC AND EXTRADIENCEPHALIC NEUROVEGETATIVE SYSTEMS IN CASES OF SINUSITIS. C. PORTA, Arch. ital. di otol. **51**:163 (April) 1939.

Porta studied the changes in the hypophysis and diencephalon in 8 cases of inflammation of the posterior group, and in 12 cases of inflammation of the anterior group, of nasal sinuses. The report of the clinical study is preceded by a discussion of the structure and function of the region and by the details of an experimental study of rabbits subjected to chemical inflammation of the nasopharynx. The results of the animal experimentation were that after cauterization of the pharyngeal vault extended over months distinct pathologic changes occurred in the hypophysis and diencephalon (hypothalamus).

In patients with inflammation of the posterior sinuses, the investigation included examination of the psyche, the habits of sleep, the basal metabolism, the

exchange of water, carbohydrates and fats, the elimination of chlorides, the vasopressure system of the blood, the thermoregulator system and the sexual apparatus, investigation of polyphagia and general physical and roentgenographic examinations. In patients of the second group, the examination of the extradiencephalic system included study of the photomotor reflex, Negro's reflex, Much's reflex, the nasolacrimal, nasovasodilator, oculocardiac, sudoral and pilomotor reflexes and dermographism. In addition, pharmacodynamic tests with epinephrine and amyl nitrite were undertaken.

The research showed indubitably that both the diencephalic and the extradiencephalic, vegetative nervous system are altered by neighboring infectious processes, sinusitis playing a role of great importance. These changes produce dysfunction, represented in the first group by psychic syndromes (emotivity and suggestibility and sometimes hysterical manifestations), disturbed sleep (hypersomnia and dissociation of sleep into its component parts), polyuria and polydipsia or oliguria, changes in the blood (increase of red cells, leukocytosis, deviation to the left in Arneth's formula and hyperglycemia), variations in temperature and adiposogenital dystrophy. In the second group were observed increase of the nasolacrimal and nasovasodilator reflexes, changes in the oculocardiac reflex, a positive reflex of Much, dermographism with increase of the permeability of the capillaries, Claude Bernard's syndrome and the sphenopalatine syndrome. Ethmosphenoid sinusitis causes disturbances in the diencephalon and less so of the extradiencephalic nervous system. Inflammation of the anterior ethmoid and maxillary sinuses affects by preference the sphenopalatine system. Isolated frontal sinusitis rarely causes disturbances of the neurovegetative system.

DENNIS, San Diego, Calif.

A CASE OF PROBABLE NASOMAXILLARY LUPOSYPHILITIC HYDRIDISM. G. SAIBENE, Arch. ital. di otol. **51**:201 (April) 1939.

The patient described by Saibene was a girl aged 12 years who had a destructive, ulcerating lesion located in the nasal vestibule and involving the bone of the septum and the maxilla. The preliminary diagnosis was lupus. Appropriate treatment being inefficacious the presence of syphilis was suspected, and a Wassermann test gave positive results. Antisyphilitic medication caused prompt and rapid recovery.

The author discusses the etiologic diagnosis at length. In favor of lupus were the hypertrophic vegetating character of the ulceration, with rosy gray nodules, and the discovery in the biopsy material of tuberculous granuloma and acid-fast bacilli. The deep-seated involvement of the bone and the prompt improvement following antisyphilitic treatment indicated syphilitic participation. The failure of the patient to react to the tuberculin test does not invalidate the diagnosis of lupus, since it has been shown by Tarentelli and others that anergia to tuberculin may be present in patients with late syphilitic manifestations and a strongly positive Wassermann reaction. The improvement in the tuberculous element in the lesion, along with the syphilitic component, is explained by increase in the general bodily resistance, induced by the antisyphilitic treatment.

DENNIS, San Diego, Calif.

SINUSITIS IN ALLERGIC PERSONS. WILHELM SCHOLZ, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:14 (March) 1939.

The author discusses the role of polypi in sinusitis and believes that they are usually of an allergic origin. Ordinarily, the pathologic conditions found in a sinal infection, such as polypi and granulations, rapidly give way to a normal status after a thorough and proper radical operation. However, when this does not occur readily an allergic influence can be assumed, to determine which it is necessary to make a detailed study of the nasal secretions and the blood smears

for eosinophilia. In addition, other allergic studies should be made, such as cutaneous testing, the control of the blood picture by injections of splenic extract and the determination of the potassium-calcium quotient.

The author states that often there may be a marked increase of eosinophils in the blood during an attack of hay fever or vasomotor rhinitis but that there may not be any marked changes in the mucous membrane of the nose, such as edematous polyposis. On the other hand, during the height of an asthmatic attack, there may also be a marked decrease of eosinophils in the blood.

In discussing the therapeusis, the author expresses the opinion that the removal of every possible focus of irritation is important. Proper ventilation of the sinuses must be established. Calcium, given either intramuscularly or by mouth, in combination with phosphorus, is usually beneficial. Perhaps most important is the dietary control, and he recommends a purely vegetarian diet as ideal. He also recommends the cauterization of both the inferior and the middle turbinate with trichloroacetic acid.

PERSKY, Philadelphia.

ABSCESS OF THE NASAL SEPTUM OF DENTAL ORIGIN. M. LACROIX and KARAITIDIS, Oto-rhino-laryng. internat. **23**:169 (April) 1939.

Odontogenous abscess of the septum is rare; only some 30 cases were culled from the French and foreign literature by Terracol in 1937. Various opinions of the pathway of the infection from the tooth to the septum have been expressed, the most probable course being by continuity of tissue.

Two cases are reported, both patients being in their teens. In the first patient, the source of the infection was a perialveolar abscess; in the second, it was a periapical focus. The connection between the dental and the septal abscesses was established by passing a probe from one to the other and then taking a roentgenogram.

DENNIS, San Diego, Calif.

Miscellaneous

ETIOLOGY OF CHOREA: ITS RELATION TO RHEUMATIC FEVER AND HEART DISEASE. S. J. USHER, Canad. M. A. J. **39**:565 (Dec.) 1938.

Usher presents the results of his study of 105 patients who were admitted to the rheumatism pavilion of the Children's Memorial Hospital of Montreal for treatment of chorea. In 56 the condition was purely chorea; i. e., the patients showed no rheumatic symptoms. In 49 chorea was mixed with rheumatic symptoms.

If the patients with infected tonsils and repeated infections of the upper respiratory tract were omitted from the group with pure chorea, only 14 per cent showed evidence of endocarditis. In the group with chorea and rheumatic symptoms 65 per cent showed heart disease.

Usher believes that valvular heart disease in patients with chorea is due not to the chorea per se but to intercurrent attacks of polyarthritis or severe infections of the upper respiratory tract associated with infection of the tonsils. He believes also that more should be made of psychic disturbances, removal of which will do more to prevent recurrences than removal of foci of infection.

MOORE, Omaha. [AM. J. DIS. CHILD.]

OTOLARYNGOLOGIC SUGGESTIONS IN PEDIATRIC PRACTICE. H. DINTENFASS, Pennsylvania M. J. **42**:226 (Dec.) 1938.

Acute Sinusitis and Acute Rhinitis.—In the treatment of these conditions pediatricians should remember that the prime object is to assist nature. Recalling that the three lines of defense against infection are (1) the mucous film, (2) the ciliated epithelium and (3) the highly vascular submucosal stroma, one should employ remedial measures which do not disturb the function of these defense

mechanisms. Local treatment of the nose should be mild and nonirritating. It can safely be said that the less intranasal treatment the better. Ephedrine and other shrinking solutions, while they produce temporary relief from nasal stuffiness, have the great disadvantage of causing secondary relaxation of the vascular layer of the submucous tissue, with resultant bogginess of the turbinate structure, interference with the normal flow of mucus and disturbance of ciliary movement.

Acute Otitis Media.—A knowledge of the anatomic variations and peculiarities of the middle ear of the infant and the young child is essential in a consideration of the subject. The eustachian tube in the infant is unusually short and wide and more horizontally placed than in the adult, accounting for the frequency of middle ear and mastoid disease secondary to nasal infection. In the infant there is no bony canal; the inner end of the membranous canal is attached directly to the rim of the drum head. Moving the auricle, therefore, in the presence of acute otitis media is productive of pain.

Paracentesis of the tympanic membrane should be done if despite conservative measures pain or restlessness continues for more than twenty-four hours in association with bulging or reddening of the drum head with or without fever. The contents of the middle ear should never be left to perforate spontaneously. The patient is put to bed and kept there until the ear becomes perfectly dry. It is a good rule that under no circumstances may a patient be up and about when there is an acute discharge from the ear. If these instructions are adhered to, the possibility of mastoid involvement is lessened.

LOGUE, Williamsport, Pa. [AM. J. DIS. CHILD.]

"APHASIA" IN A PARTIAL DEAF-MUTE. MACDONALD CRITCHLEY, Brain **61**:163, 1938.

Hughlings Jackson suggested that focal cerebral lesions may damage or destroy the execution of sign language by a deaf-mute. Critchley reports a case in which strong support is furnished for Jackson's contention, although complete proof is lacking.

A man aged 42 had been well until the age of 7, when he gradually lost his hearing and was taught finger spelling. At 14 he was stone deaf and was admitted to an institution for deaf-mutes, where he was taught lip reading. After leaving the school he relied chiefly on manual signs and finger speech to communicate with others. Paralysis developed on the right side, and for three days he was deprived of what little articulate speech had previously been possible to him. Paralysis, like speech, improved to a certain degree. As soon as he was able to hold a pen it was found that he could neither write nor perform on paper simple arithmetic calculations. He could no longer read lips. For a few days after the stroke he was unable to understand people who communicated with him by finger spelling. The ability returned in a few days, but he was still unable to reply on his hands. Articulate speech was infrequent and considerably altered. Speech was dysarthric and ungrammatical; he seemed to rely little on this means of communication. He remained under observation for the next two years, during which his condition changed little, if at all.

No similar case is recorded in the literature. Grasset (1896) reported the case of a deaf-mute who lost his ability to make hand signs after a cerebral vascular lesion. The patient was able to read with understanding and to comprehend finger talk in others. He was unable, however, to reply in the finger alphabet with the right hand, but could do so with the left. Grasset concluded that in the deaf-mute a center for manual speech develops in the cortex, independent of the motor area of the upper limb. He located this tentatively at the foot of the second frontal convolution of the left hemisphere.

In Critchley's case, the natural sign language was not impaired. The circumstances were unusual, however, in that the patient had never been proficient in this means of communication and preferred lip reading or finger spelling. This may be ascribed to a variety of reasons, especially to the fact that hearing was intact for the first few years of life, during which articulate speech developed normally. For this reason, the patient cannot be regarded as having "complete" or congenital deaf-mutism. Hughlings Jackson's surmise therefore remains unverified, as it referred explicitly to a natural system of signs and not to finger spelling. It is justifiable to suggest that a much more severe lesion would be required to abolish the primitive sign language than the elaborate system of dactylology.

SALL, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

CAUSE OF PARALYSIS IN DIPHTHERIA. I. TAYLOR, Brit. J. Child. Dis. **35**:250 (Oct.-Dec.) 1938.

Taylor discusses some of the evidence bearing on the manner in which diphtheria toxin attacks the nervous system. The view held by some authors is that all forms of diphtheritic paralysis are due to hematogenous toxemia, the frequency with which certain nerves are attacked being explained by the selective affinity of the toxin for these nerves. The close anatomic relation between the site of infection and the initial paralysis has led other observers to discard this theory in favor of different views. They state that the toxin first attacks the nerves in the locality of the site of infection and that all other paralyses are produced by diffusion of toxin in the nervous system from the point of entry. This view receives some support from the orderly sequence of paralyses commonly noted in faucial diphtheria. The two schools of thought meet in the theories advanced by Walshe, (1) that the initial paralysis is caused by lymphogenous invasion of the nervous system, the toxin passing from the site of infection to the central nervous system by the perineural lymphatics, (2) that generalized paralysis is the result of hematogenous toxemia and (3) that paralysis of accommodation is the result of the selective affinity of circulating toxin for certain elements of the nervous system. Most clinicians and experimental workers are agreed that the late multiple neuritis following diphtheria, giving rise to diphtheritic pseudotabes, is due to hematogenous toxemia. The strongest evidence of the hematogenous origin of such paralyses is the fact that the experimental injection of diphtheria toxin intravenously into animals produces a multiple neuritis which is exactly comparable with this late form of peripheral neuritis accompanying diphtheria in the human being. In addition to paralysis of the limbs, paralysis of accommodation must be included in the group of symptoms due to blood-borne toxin, because this form of paralysis is found frequently in both faucial and extrafaucial diphtheria. There are good grounds for believing that hematogenous toxemia is capable of producing, in addition to generalized paralysis, a type similar to the local paralysis found in faucial diphtheria. The author believes that one may thus accept the possibility that blood-borne toxin may play a part in the production of local paralyses encountered in faucial diphtheria. The close anatomic relation between the local paralysis and the site of infection can leave no doubt that the nervous system is primarily attacked by local absorption of toxin. Unilateral faucial diphtheria frequently results in paralysis of the corresponding side of the palate. An important and familiar clinical observation is what has been described as the "march of paralysis." One cannot but be impressed by the orderly way in which paralysis develops in most severe forms of the disease, palatal paralysis preceding pharyngeal and the diaphragm being involved before the intercostal spaces. Such a march suggests the slow spread of toxin in the central nervous system.

J. A. M. A.

SOME ETIOLOGIC FACTORS IN THE PATHOLOGY OF STAMMERING. I. LATIF, Brit. J. M. Psychol. **17**:307 (Dec.) 1938.

Latif finds that claims to one universal treatment in all cases of stammering are not justified by actual results and that, whereas some disorders of speech yield to one kind of treatment, a large number of patients remain unaffected by it. The author attempts an analysis of a few etiologic factors in the onset and cure of stammering by presenting 2 sample cases from his clinical investigations. These cases illustrate that the causes of stammering and its treatment vary from one case to another. The first case shows that although stammering may have its inception in the factors (fear of parents, sense of guilt because of masturbation, inferiority, imitation and fear of a stammering heredity) which may be regarded as more or less primary, other conditions, such as lack of steady control over breathing and voice and faulty habits of reading, may further complicate the etiologic factors in the disorder during the course of its development. Consequently, no therapeutic measure can be really effective unless, with the primary factors, it takes into account secondary conditions. Besides the analysis of the second patient's difficulties (which were similar to those of the first) when he was in a state of relaxation, the author also tried a few exercises of musical drill with him. In addition to this, he assigned a few tasks requiring delicate handling of instruments in the laboratory in order to help the patient overcome his sense of inadequacy in manual skill. The period of treatment lasted eleven months, after which the patient was completely cured. Oral or phonetic exercises were not resorted to during the entire course of treatment. J. A. M. A.

ASSOCIATION OF STAMMERING AND THE ALLERGIC DIATHESIS. A. M. KENNEDY and D. A. WILLIAMS, Brit. M. J. **2**:1306 (Dec. 24) 1938.

Kennedy and Williams examined a consecutive series of 100 children who stammered. These children were from 5 to 14 years of age. Of the children examined, 81 were boys and 19 girls; 89 proved to be right handed and 11 left handed, and 65 gave a family history of stammering and 35 no such history. Fifty-two children gave a personal history of allergic manifestations: Thirty-two complained of migraine alone or in combination with urticaria and/or asthma or with asthma plus eczema; 11 complained of urticaria alone; 8 had a history of asthma alone or combined with eczema and/or hay fever, and 1 suffered only from eczema. Thirty of these 52 children also gave a history of "fastidiousness" with regard to food generally and dislikes or refusals of particular foods or gastrointestinal upsets after them. Of the 52 children with a personal history of allergy, 48 also had a family history of allergy. In 37 cases one or both parents exhibited allergic manifestations, and in 6 a grandparent, in 4 an aunt and in 1 a sister was the nearest sufferer. Thirty-three of the 52 children (including the 4 with no allergic family history) had a family history of stammering. Seven of the 52 children were left handed; 6 of these 7 had a family history of allergy and 2 also a family history of stammering. Of the 48 children who did not give a personal history of allergic manifestations, 47 had a family history of allergy. Fifteen of these children, however, gave a history of "fastidiousness" with regard to food generally and dislikes or refusals of particular foods or gastrointestinal upsets after them. In 37 of the 47 cases one or both parents suffered from allergy; in 5, a grandparent; in 2, an aunt, and in 3, a sister. Thirty-two of the 48 children (including the one with no allergic family history) had a family history of stammering. Four of the 48 children were left handed, and all 4 had an allergic family history. Three also had a family history of stammering. The close and practically constant association of stammering and allergic manifestations in the personal and family histories of the stammerer revealed by the present investigation favors the view that there is something more than a casual relation between stammering and the allergic diathesis. J. A. M. A.

ESSENTIAL NEURALGIA OF THE FACIAL NERVE. CARLOS CHARLIN, Ann. d'ocul. **175**:894 (Dec.) 1938.

Persistent neuralgia of the facial nerve of unknown cause which is resistant to all treatment and lasts for many years and sometimes for a lifetime is frequent. Both etiologic research and symptomatic therapeutics have been without avail. Most patients with this type of neuralgia are submitted time and again to antisyphilitic treatment, to protein therapy of many kinds, to removal of teeth and to nasal operations, without relief. Neurologic investigation generally shows idiopathic neuralgia to be one of five types: (*a*) essential neuralgia of Sicard, (*b*) sympathetic neuralgia, (*c*) cyclic neuralgia, (*d*) causal neuralgia and (*e*) secondary neuralgia. The cause of the last type also is unknown.

Observations on the first 50 patients are summarized. All of them were given neurologic, medical, ophthalmic, otorhinolaryngologic, dental and phthisiologic examinations before treatment was started. Phthisiologic observations on the first 40 patients only are analyzed. Of this series, 18 had a tuberculous history; tuberculous lesions were found at the site of the neuralgia in 10, and 31 had thoracic bacillary lesions, which were clinically active in 5. Improvement was noted in most of the patients after tuberculin therapy, bacteriologic treatment and specific therapy.

S. H. MCKEE. [ARCH. OPHTH.]

MORPHOLOGY OF EPULIS. L. GERY and O. NOEPPEL, Bull. Assoc. franç. p. l'étude du cancer **27**:137, 1938.

Gery and Noeppel define epulis as a sessile or a pedunculated outgrowth of the gum, originating from its soft tissue. They studied 240 such growths seen between 1919 and 1937 at the Institute of Pathology in Strasbourg, France, and found 230 of them to be hyperplastic tumors of the mesenchyma or, rarely, of the alveolodental ligament. All were benign, though some recurred locally. Histologically they could be divided into four not sharply separated groups: the inflammatory, the vascular or angiomatous, the fibrous and the giant cell group. Transitions among them were so frequent that a histologically homogeneous form was rare. The inflammatory epulis consisted of granulation tissue rich in blood vessels and in an exudate that sometimes was leukocytic but often plasmocellular. The vascular epulis showed excessive formation of blood vessels, which lacked the regularity and arrangement that are characteristic for granulation tissue. The fibrous epulis was made up predominantly of fibroblasts with varying amounts of intercellular fibers. Two types of cells determined the giant cell epulis: a small mononuclear cell resembling a fibroblast but easily differentiated from it and the well known multinucleated giant cell, similar to the bone marrow giant cell. The small cells, which could be shown to be connected with each other by means of protoplasmic outgrowths, are considered by Gery and Noeppel to be the fundamental unit of the growth. The hypotheses concerning the formation of the giant cells are discussed in detail. Their mesenchymal origin and lack of any relation to the bone marrow giant cells are emphasized, and the name "histioplaxe" is suggested for them. In all the forms of epulis, deposits of collagenous masses were found, as well as ossification. The latter is explained as the function of the histiocyte in the sense of Maximow's polyblast. The deposition of calcium in the preformed osteoid tissue, as well as calcification without formation of bone, is brought into relation with the observation that not infrequently decalcification of the alveolar process was recorded, with transport of calcium, much as in the formation of calluses. New-formed cartilage was observed rarely. The authors emphasize the evidence against the origin of the epulis from bone. In their opinion, the epulis is formed by the reticulum in response to an unknown irritating factor. The histiocyte, with its formative potentialities, is fully capable of explaining the morphologic variations of the epulis and the frequent observation of phagocytosis.

I. DAVIDSOHN. [ARCH. PATH.]

GLOSSOPHARYNGEAL NEURALGIA—RECURRENCE AFTER INTRACRANIAL SECTION OF THE NERVE. W. S. KEITH, Confinia neurol. **1**:345, 1938.

Keith reports the case of a woman aged 75 who complained of terrific attacks of pains just in front of the left ear. The pains were preceded by sudden twisting sensations in the left side of the throat and were brought on by swallowing. The left glossopharyngeal nerve was divided, with complete relief from symptoms. Two years later the patient again felt slight pains in the left side of the neck, and four months later a major attack occurred. The upper half of the vagus root and the nerve of Wrisberg were divided, and this was followed by complete freedom from attacks.

DE JONG, Ann Arbor, Mich. [ARCH. NEUROL. & PSYCHIAT.]

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

GEORGE T. JORDAN, M.D., *President*

Regular Monthly Meeting, Oct. 2, 1939

Pathologic Changes of the Inner Ear in a Case of Deafness from Epidemic Cerebrospinal Meningitis. Presented by DR. ELMER W. HAGENS.

A fatal case of epidemic cerebrospinal meningitis is reported, in which deafness occurred forty-six days before death. The temporal bones were obtained, and microscopic examination of the labyrinths was made. The observations support the reports in the European literature of severe, bilateral destructive labyrinthitis, with tendency toward healing in the form of granulation tissue and bone. The end organs were practically destroyed and demonstrated why permanent total or nearly total loss of cochlear and vestibular function occurs.

Five weeks prior to admission to the hospital, the history stated, in a 3 year old boy high temperature, projectile vomiting and coma lasting about one week developed. On recovery it was noted that he could not hear. About eight days before admission high temperature again developed. At the hospital it was found that the neck was rigid; the Kernig, Brudzinski and Babinski signs were positive. Spinal puncture revealed increased pressure and cloudy fluid with 850 cells and a 2 plus reaction to the Pandy test, which, on culture, was shown to contain meningococci. In spite of administration of antitoxin intravenously and general supportive measures, the child's condition became worse, and death occurred about forty-six days after deafness was noted. During the hospitalization otitis media was not noted. A general postmortem examination showed suppurative leptomeningitis (epidemic type), focal bronchopneumonia, severe parenchymatous degeneration of the myocardium, kidneys and liver and infectious hyperplasia of the spleen.

The slides illustrate a microscopic study of both temporal bones. Apparently there had been a diffuse suppuration of the labyrinths. At the time of death the process had undergone resolution, and granulation tissue had filled in a considerable portion of the labyrinth. Destruction of bone had occurred about the semicircular canals, but only moderate evidence of bone building was observed. In the right ear the spiral ganglion and the organ of Corti were practically destroyed; the vestibular organs also were missing, although the Scarpa ganglion was intact. In the left ear the spiral ganglion was present, and a distorted organ of Corti was seen in the basal coil. The vestibular end organs were recognized but were no doubt functionless. Both divisions of the eighth nerve were present in the internal auditory meatuses of the two ears, but the number of polymorphonuclears along the nerve tissue pointed to the spread of the infection to the labyrinths along this pathway. Some mononuclears and polymorphonuclears were noted also in the aquaeductus cochleae. The fossa for the oval and round windows and the pneumatic spaces showed moderate infection; no pathway from these regions to the labyrinth was noted. The connections from the semicircular canals to the tunica propria of the pneumatic spaces were doubtless due to destruction of bone by the labyrinthitis. The drum membranes and remaining parts of the middle ear were destroyed at autopsy and were therefore not observed.

Politzer discussed this subject, but, because of the scarcity of reports in the American literature, it is believed worth while to record this case.

DISCUSSION

DR. JOHN R. LINDSAY: The sections which Dr. Hagens showed are excellent illustrations of the changes which occur in the labyrinths when there is invasion from the meninges. Temporal bones from such cases are not easily found, and therefore reports in American literature have been scarce or absent.

I have had the opportunity of examining several specimens of Professor Nager's collection in which the meningitis had occurred many years before death, and in most of these the labyrinthine spaces had been completely obliterated by formation of new bone. The question comes up, then, whether the lesions described by Dr. Hagens, if the patient had survived, would have gone on to extensive ossification and obliteration of the labyrinthine spaces with complete loss of function or whether this might have been one of the cases in which some vestiges of function remain.

Until recent years the meningococcus has been responsible in most cases for total or subtotal loss of hearing due to meningitis. Now that some cures of streptococcic and pneumococcic meningitis are being obtained, total deafness is likely to appear in some of the cases. I had the privilege of examining 1 patient so afflicted last year.

There is good reason to believe that labyrinthitis from meningococcic meningitis behaves in essentially the same way as labyrinthitis from streptococcic or pneumococcic meningitis, and I have more than 60 bones affected with the latter condition in my collection. I have selected a few slides to show some of the early steps in the invasion of the labyrinth from the meninges and also some of the later observations in cases of labyrinthitis of long standing.

Slides 1 and 2 illustrate a collection of pus at the mouth of the aquaeductus cochlearis; slide 3, invasion of the scala tympani through the mediolus; slide 4, healed labyrinthitis, showing new bone and connective tissue in the scala vestibuli and scala tympani and marked dilatation of the ductus cochlearis; slide 5, a section through the basal coil near the round window, showing bone overlying the mouth of the aquaeductus cochlearis.

DR. ALFRED LEWY: I should like to report a case which was somewhat parallel to that of Dr. Hagens, although histologic evidence is not available. The patient was a girl aged 7 who entered Cook County Hospital with frank meningitis from which the hemolytic streptococcus was cultured on three or four occasions, after otitis media on the right of about two weeks' duration. The left ear was totally deaf, with no response to caloric stimulation. Dr. Leshin did simple mastoidectomy, uncovering the dura on the right side. On the left side a radical operation was done, with no signs of infection of either the middle ear or mastoid cells. As the patient had had good hearing prior to this, it was believed that the destruction of hearing in the left ear was due to involvement of the inner ear or the nerve by meningitis originating from the right ear, due to Streptococcus haemolyticus. The patient recovered but for months afterward was unable to walk steadily in the dark. That was about two years ago, and she still shows some mental instability and is easily fatigued and able to attend school only part time.

DR. FRANK NOVAK: I should like to ask Dr. Hagens whether the cochlear involvement preceded the vestibular.

DR. HOWARD BALLENGER: I should like to ask Dr. Hagens whether when he looked up the literature he found the pathologic picture in any of the cases that of meningoneuritis rather than labyrinthitis. One sees frequently in infectious conditions such as mumps and scarlet fever, with or without involvement of the middle ear, what is presumed to be meningoneuritis rather than septic labyrinthitis. Patients with neuritis would be more likely to have marked partial deafness than to be totally deaf. The static branch to the labyrinth may or may not be involved. Some cases of marked deafness in meningococcic meningitis may be this type. Such reports as Dr. Hagens has just made offer the only way to settle the question.

DR. ELMER W. HAGENS: I cannot answer Dr. Novak's question—I could not tell whether the cochlea was involved first. I could not tell from the sections and did not have the history. I never saw the child and was given what history there was by the resident.

With reference to Dr. Ballenger's question, I have always wondered what the pathologic picture is in such cases. I have read of, but never observed, such a case. When the 5,000 children were examined I wondered just what the pathologic picture was and determined that if such a case were ever available I would follow it up and see what the labyrinths showed. In this case there is destruction of the organ of Corti and loss of spiral ganglion cells in one ear and partial loss in the other. Scarpa's ganglion cells were intact in both ears. I did not look up the literature completely. I do not recall a statement that the pathologic picture was that of neuritis only. As a rule neurolabyrinthitis is mentioned, and I think from the case I have and from what I found in Politzer's discussion that this designation is accurate.

Surgical Treatment of Cancer of the Larynx. Presented by DR. CHEVALIER L. JACKSON, Philadelphia.

Surgical treatment has the best statistical results to show in the therapy of cancer of the larynx, but in certain cases the patient may be permitted a choice, or the laryngologist may feel justified in advising irradiation. The ultimate prognosis will be best in the better differentiated, slower-growing, "lower grade" tumors, regardless of the method of treatment. "Grading" should be taken into consideration in selection of treatment, particularly in borderline conditions, and the less differentiated "higher grade" tumors should incline one toward more radical surgical intervention or irradiation, although in such cases prognosis is poor with any method of treatment.

Surgical Indications.—1. Lesions occupying the middle third of one vocal cord are suitable for the operation of laryngofissure by the "clipping" technic, regardless of histologic character or grading. 2. Lesions reaching the anterior commissure and even involving the opposite cord are amenable to extirpation by laryngofissure also, but in such cases the Chevalier Jackson "anterior commissure" technic should be used. 3. Lesions in which the growth is chordal but has reached the posterior end of the cord and produced impairment of motility or has extended subglottically call for total laryngectomy.

Laryngectomy and pharyngotomy are done also when the lesion is "extrinsic," but the results in such cases are unsatisfactory, and it is possible that irradiation would accomplish as much in arresting the growth and prolonging life. On the other hand, for some of the extensive lesions, especially for those with involvement of cartilage or perichondritis, there may be some advantage in removing the larynx as a preliminary to irradiation.

The indications for and technic of laryngofissure and laryngectomy as carried out at Temple University Clinic are given in detail, and voice and speech instruction follow operations on the larynx.

DISCUSSION

DR. PAUL HOLINGER: I know that all members of this society appreciate the vast experience that has given the significant conclusions which Dr. Jackson presented on this highly controversial subject.

I was glad Dr. Jackson stressed the necessity of biopsy in spite of the fact that his paper dealt only with treatment. Certainly the grading of the lesion is an extremely important factor in the choice of therapy, to say nothing of the importance of biopsy in establishing an accurate diagnosis.

The extremely interesting question of the voice after operations on the larynx was beautifully illustrated with the sound motion picture film. There is a great danger, however, of attempting to rationalize in the choice of a surgical procedure in an effort to give the patient a good voice. This is usually only wishful thinking, dangerous not only to the patient but also to the final statistical analysis

of the merits of the various procedures. If laryngologists could adhere strictly to the indications Dr. Jackson stressed, possibly their series of permanent cures could approach the 85 per cent he reported for suitable cases.

One question I should like to ask deals with work being carried out at Temple University by Drs. Fay and Smith. Has any experimental work been carried out in refrigeration to relieve the pain of far advanced extrinsic carcinomatous lesions of the larynx?

DR. FRANCIS LEDERER: A year ago this society opened its season with a similar discussion of cancer of the larynx, and at that time I had occasion to speak about rehabilitation of the voice and showed a number of examples. I have not been so fortunate as Dr. Jackson in getting the perfect voice he demonstrated in his patients after laryngofissure. Perhaps my patients have not used the ventricular bands as much as his have. It is a startling and excellent result.

I have always been interested in the rehabilitation of the voice after laryngectomy, because it would be a severe jolt to a patient if one could not promise any voice. On previous occasions the opportunity has been offered to observe patients who have developed a buccoesophageal voice after laryngectomy by their own efforts, and the value of instruments that are made to give the patient an artificial voice has been demonstrated. I wish to introduce—apologetically, because I feel personally grateful to the Western Electric Company for their efforts in making the artificial larynx, having in mind that patients have not universally responded well to it—an apparatus which Dr. Jackson has seen before, demonstrated by its originator, who himself is a laryngectomized patient and who knows what a voice should sound like. By his efforts and those of Dr. Hanson, of East St. Louis, Ill., a device has been worked out which is the best I know of. It takes away the metallic sound which characterized the other instruments and allows for modulation of the voice as they do not. So I have asked the same woman who addressed this society last year to demonstrate the instrument to which she introduced me.

(The patient, Mrs. B., stated that her present apparatus [the artificial larynx of Roberts-Hanson] has produced an effortless modulated tone. She has found that whereas other types of artificial larynx make necessary a concerted action of the diaphragm, the use of this apparatus can be learned with greater ease. While she is particularly grateful for the previous instruments that have been produced, the apparatus which she now possesses is one that has made her happy.)

DR. THOMAS C. GALLOWAY: I think that the members of this society are fortunate to have Dr. Jackson demonstrate again that by a relatively simple procedure in properly selected cases the patient with laryngeal cancer has an 85 per cent chance of cure with a useful voice and a normal airway and a chance for a normal life with little risk to himself. I think that it is too bad that this information cannot be more widely disseminated, because in Chicago the feeling has become widespread that irradiation is the treatment of choice for such a carcinoma.

It is too bad this presentation could not reach the men who saw the advertising of a certain device for the application of radium in the larynx in a local medical publication. This device may have possibilities and has been useful in at least 1 case. But its advertising implies to the general practitioner that such a method offers a cure for cancer with no risk, no pain and no distress, though there is little evidence to support such implication.

I think that all the members of this society agree with all that Dr. Jackson has said, especially that in proper cases in which there is no fixation of the cord and in cases of early cancer in the anterior half of the vocal cord laryngofissure is the treatment of choice. I do not wish to deprecate the value of irradiation for many conditions, but I do not think that the impression should go abroad that at present anything can replace laryngofissure as the most satisfactory procedure in properly selected cases of early carcinoma.

DR. GEORGE E. SHAMBAUGH JR.: Little can be added to this complete and excellent demonstration. I think Dr. Jackson should receive particular credit for

introducing the dissection of the anterior commissure, which allows more patients to be cured by laryngofissure. I have used this procedure for 2 patients, 1 of whom has been presented. One item in technic was the use of a surgical diathermy cutting current in removing the cord after exposing the larynx except for the vocal process of the arytenoid, which has to be cut off by scissors. The removal was done entirely bloodlessly and quickly and easily.

DR. THEODORE WACHOWSKI: I should like to comment on what Dr. Galloway said in regard to so-called advertising. I would like to say that the Roentgen Society has recognized these facts and is trying to have that type of advertising eliminated. I think that if the sentiments of this society are made known the Chicago Medical Society will try to permit only ethical advertising in the *Bulletin*. I think that the things Dr. Galloway referred to should not be permitted and will not be.

DR. L. B. BERNHEIMER: If I understood correctly, Dr. Jackson said that with intrinsic, infiltrating lesions of the larynx the patient is given his choice between total laryngectomy and irradiation. I should like to know what Dr. Jackson's end results have been when radiotherapy was employed for this particular type of lesion. I ask this question because I am associated with an institution where a large number of laryngeal lesions are seen and where irradiation is used extensively, and it has been the experience of my associates and me that an infiltrating lesion resulting in cordal fixation never responds to irradiation. That is one type of lesion with which we do insist on surgical treatment, that is, laryngectomy. I cannot recall a single five year cure of an infiltrating laryngeal lesion treated by irradiation.

DR. L. Z. FISHMAN: I should like to ask Dr. Jackson in how many of the cases intrinsic carcinoma of the larynx was anaplastic and in how many it was of the slow-growing type.

DR. ADOLPH HARTUNG: The discussion did not deal with the relative value of irradiation and surgical intervention, and I have, therefore, little to add. Certainly results with irradiation have not been satisfactory so far as the ultimate outcome is concerned. I think that surgical intervention still has a place of choice except in special instances in the treatment of early lesions of the larynx.

DR. CHEVALIER L. JACKSON, Philadelphia: I appreciate the contributions of all those who joined in the discussion. Dr. Holinger asked about refrigeration. I have been asked about that before, but I cannot say anything about it, because, so far, my associates and I have not contributed any of the patients on whom Dr. Fay and Dr. Smith have made these experiments. I say "experiments," because patients are still being taken for that work on the basis of a clear understanding by the physician and the patient that refrigeration is purely experimental as yet and that nothing can be promised. So far we have not referred any patients from our service. However, Dr. Fay and Dr. Smith are continuing their studies and will report further on them.

I was much interested in Dr. Lederer's presentation and the excellent demonstration of the apparatus given by his patient. Certainly the mechanical larynx is an attractive field for continued and further work. It is the practice of my associates and me to give our patients postoperatively a systematic course of instruction first, to give them an opportunity to develop the buccoesophageal voice, which can be developed by many patients, more easily by men than by women. The work which in the United States was started by Morrison, of New York, is certainly productive of a better voice without apparatus than most patients will obtain without systematic instruction. On the other hand, when a preliminary period of training without apparatus has been given, the next thing is to get the patient in touch with one of the better forms of apparatus, and it is from the patients themselves that most of the important improvements in apparatus have come.

I thank Dr. Galloway for his emphasis on some of the points in connection with laryngofissure. Dr. Babcock, in his department, uses steel wire in all sorts

of cases, those in which the neck is operated on and other cases, and my associates and I took it over for buried sutures in the neck and have found it extremely satisfactory. The chief point in its favor is that experimental work has shown that its use is singularly free from irritating reaction in the tissues. When the sutures are superficial they may be felt under the skin and occasionally will be annoying and have to be removed, but if deep enough they cause no irritation whatever. We have been using them long enough to be well satisfied. On the other hand, I do not wish to lay any great stress on that point. Doubtless other materials are just as good, but we have used steel wire enough to feel that we want to continue with it. One point is that it is considerably stronger than silver. There are several different strengths, but in the size we use it almost never breaks.

I wish to congratulate Dr. Shambaugh on the excellent result in the patient whom those present saw this evening. I think the voice will still improve. My associates and I have found that the improvement continues for a number of years. I think that it is unwise to force the patients. The voice should be cultivated in quiet places and not forced in noisy ones. I think that this patient will get greater improvement, although the voice may be higher pitched than normal because of the shortness of the cords. The larynx is symmetric, with no granulomatous approximation, and I think that the voice will improve. One patient that we have, six or seven years after laryngofissure, asserts that every six months she can make a comparison with her friends and be assured that she is not wrong in her own conviction that her voice carries further and is still improving.

Dr. Wachowski's remarks do not call for a comment from me, as I am not familiar with the matters concerned. In regard to Dr. Bernheimer's point, which is important, my associates and I do not give the patient the choice. I said that in cases in which laryngofissure is not suitable for one reason or another we take the patient into consideration and go over the problem with him and his family but not in cases in which motility is impaired. I do not say that the conditions for which operation is not done are necessarily good ones for irradiation. However, if laryngectomy is not done, some treatment must be given. I have not the figures at hand as to what percentage were anaplastic. I know that it is a great minority.

Book Reviews

Surgery of the Nose and Sinuses. By Harry Neivert, M.D. First Chapter of Volume VIII of Nelson Loose-Leaf Surgery. Pp. 236, with 205 illustrations. New York: Thomas Nelson & Sons, 1939.

This chapter is a small volume in itself and is designed as the first chapter of a new section (volume 8) of the well known and deservedly popular Nelson Loose-Leaf Surgery series. The complete volume 8, shortly to be issued, will be entitled "Surgery of the Nose and Throat," with the remaining portion contributed by Dr. John D. Kernan, who is the author of the preface to the current chapter. Revision pages for the various volumes are issued to subscribers every six months, thus keeping the reader up to date in future developments of the subject.

The chapter entitled "Surgery of the Nose and Sinuses" is well done and the subject as thoroughly covered as it can be in the number of pages employed. Necessarily, extended discussions are eliminated, and the descriptions are brief, concise and well illustrated, as the 205 plates will attest. Anatomy, physiology and pathology are well covered, in sufficient detail to satisfy the average reader, and the authors cited are authoritative in their respective fields and subjects. Indeed, the author has quoted extensively from the writings of such well known teachers as Sluder, Skillern, Eggston, Jarvis, Coates, Faulkner, Metzenbaum, Samuel Cohen and Schaeffer.

Many illustrations have been borrowed from the works of these men, but they are carefully chosen and have definite application to the subject—none are superfluous. In addition, more than half of the cuts are original, especially those pertaining to the author's own particular methods and modifications of surgical procedures.

In his foreword, Dr. Kernan calls attention to the newer conceptions of the physiology of the nose and the newer philosophy deduced therefrom, namely, more conservative treatment and surgical intervention when possible and consequently less destruction of nasal function and therefore better general bodily health. He says, "In these articles dealing with the surgical procedures, medical conditions will be taken up only as their consideration is necessary to draw the line at which medical treatment should end and surgical therapy be adopted. The surgical procedures advocated, moreover, will, so far as possible, be those which preserve structure and restore function." This extract gives the key to the whole work. Etiology, symptomatology, diagnosis and treatment (other than surgical) are briefly summarized in order to leave more space for consideration of the surgical treatment, which is the purpose of the volume.

The author has arranged his material in good sequence for easy reference. The style is clear and the typography excellent. The book is readable, with added interest from personal observations and reminiscences but with a very minimum of case reports. The bibliography contains 81 references. The resident in otolaryngology and the graduate student will welcome the addition of this book to their libraries and will make frequent use of it. The younger rhinologist will find it a safe guide and a useful ready reference for the anatomy and pathology that he may be forgetting, and every rhinologist, irrespective of age, will enjoy and profit by its perusal.

Treatment by Diet. By Clifford J. Barborka, M.D., D.Sc., F.A.C.P., Associate in Medicine, Northwestern University Medical School, Chicago; Formerly Consulting Physician, The Mayo Clinic. Fourth edition, revised. Price, $5. Pp. 691, illustrated. Philadelphia, London, Montreal: J. B. Lippincott Company, 1939.

This textbook, now in its fourth edition, brings down to date the many advances in the field of nutrition during the past two years. Some chapters had to be

completely rewritten; others, changed to conform to the newer concepts of the relation of diet to the diseased conditions under consideration.

The author has aimed to present a book that would crystallize the essentials of dietotherapy in order to enable the busy practitioner to use such practical methods as might, in given cases, aid him in his therapy. He has well succeeded in his purpose.

The book consists of 691 pages, is attractively bound and contains much information. The literary style and plan of the author will interest any reader because of the simplicity and thoroughness with which the subject matter is dealt with and discussed.

The material is divided into five parts. Part 1 deals with "Diet in Health" and covers the important points of adequate protein, mineral, acid-forming and base-forming foods, with a thorough consideration of the vitamin, water and energy requirements of man and similar data. It concludes with a discussion of the essential requirements of all diets and substitutions. Part 2 takes up the application of dietetic therapy, including the qualitative and quantitative factors and the method of calculating and applying them. Part 3 discusses "Diet in Disease" with practical methods for dietetic treatment of many diseased states. Part 4 concerns the routine hospital diets and special methods of feeding, including tube feeding and gastrojejunal feeding. Part 5 is the appendix and contains many useful charts of weights, average composition of food and many other valuable points. The bibliography is extensive and indicates to what great pains the author has gone in order to present a well balanced text. The index is complete.

Nutritional therapy is receiving greater recognition by otolaryngologists the world over, especially for certain types of sinal infection, preoperative and postoperative states and laryngeal and esophageal obstructions.

The fine presentation of the subject by the author of this book should prove helpful in many instances and merits more careful examination and reflection by otolaryngologists. It is recommended to them and to bronchoesophagologists, as well as to those taking residencies in the fields in question.

The Surgery of Injury and Plastic Repair. By Samuel Fomon, Ph.D., M.D., formerly Major, Medical Corps, United States Army. Price, $15. Pp. 1,400, with 2,000 illustrations grouped in 925 figures. Baltimore: Williams & Wilkins Company, 1939.

There has been a need for an up-to-date comprehensive textbook on the various surgical procedures available for handling injuries, malformations and new growths of the head and neck and their plastic repair. Such a book is of particular interest to the general practitioner, who sees the patients first and whose skill and care can do so much to prevent subsequent functional disability and deformity. The general surgeon, the otolaryngologist, the surgical ophthalmologist and the oral surgeon will find chapter after chapter of valuable specialized information on regions of the head and neck which is intelligently and lucidly written, satisfactorily illustrated and remarkable in its grasp of the complete literature pertaining to the development of the operative procedures for handling specific problems.

The book is divided into two main parts: The first part is devoted to the general principles of standard procedures and the newer concepts of transplantation of tissue, wounds, burns, shock, fluid, salt and acid-base balance, choice of anesthesia, the preoperative and the postoperative care of the patient. Totaling 518 pages, this portion consists of nine chapters, each of which contains numerous line drawings in black and white and in color and is complete, with an extensive bibliography.

The second part considers specific problems and their surgical management in the various parts of the head and neck. The regions have been grouped under fourteen chapter headings, including the cranium, the nose, the eyelid, the auricle, the maxillofacial region, the lip, the cleft lip and cleft palate, the mandible, the

salivary glands, surgical disorders of the skin, and casts and prostheses. The anatomy and physiologic functions are discussed. Operations are described in step by step detail when necessary and are often accompanied by similar step by step illustrations. This section contains 891 pages, including a good index. To otorhinolaryngologists the section devoted to the nose is of particular interest. It is 200 pages long and is noteworthy for its scope, clarity of presentation and excellence in illustration.

Diseases of the Ear, Nose and Throat. By Francis L. Lederer, M.D., F.A.C.S., Professor and Head of the Department of Laryngology, Rhinology and Otology, University of Illinois College of Medicine, Chicago; Chief of the Otolaryngological Service, Research and Educational Hospital. Second edition, revised. Price, $10. Pp. 840, with 765 halftone and line engravings on 463 figures and 16 full page color plates. Philadelphia: F. A. Davis Company, 1939.

A second edition of the textbook by Dr. Lederer and his associates is just off the press. Its appearance, slightly less than a year since the first publication, proves the popularity of the first edition.

The work retains the general arrangement of the first edition: the division of the subject matter into five sections; the fine presentation of the material in a style that makes for easy reading; the treatment of details of anatomy, pathology, differential diagnosis, prognosis and treatment with such literary effectiveness as to compress an enormous amount of material into 840 pages; the arrangement of the page in two columns, and the diagrams, sketches, schemata, histologic studies and photomicrographs.

Some of the sections were corrected, and various changes were made in the chapters on anatomy in order to present certain features more clearly. Improvement was made in the illustrative material.

Here and there some changes were made according to suggestions from the author's associates.

The book is recommended for medical students, general practitioners, graduate students in otolaryngology, those taking residencies and otolaryngologists.

Dr. Lederer and his associates are to be congratulated on the production of a most attractive and useful book.

News and Comment

AMERICAN BOARD OF OTOLARYNGOLOGY EXAMINATION

The American Board of Otolaryngology will hold an examination at the Manhattan Eye, Ear and Throat Hospital, New York, June 3, 4 and 5, 1940.

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Dr. Louis Ledoux, Brussels, Belgium.

Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg 143, Groningen, Netherlands.

Hungarian Otolaryngological Society

President: Dr. V. Zimányi, Zárda-u. 48, Budapest II.

Secretary: Dr. G. Kelemen, Reáltanoda-u., Budapest IV.

Sociedad Rioplatense de Oto-Rhino-Laringología (Argentine Section)

President: Dr. Raul Becco, B. Mitre 1690, Buenos Aires.

Secretary: Dr. Juan Manuel Tato, Santa Fé 1171, Buenos Aires.

Société Française d'Oto-Rhino-Laryngologie

Secretary: Dr. Henri Flurin, 19 Avenue Mac-Mahon, Paris, 17e.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. A. W. Proetz, 3720 Washington Blvd., St. Louis.

Secretary: Dr. Leroy A. Schall, 270 Commonwealth Ave., Boston.

Place: New York. Time: June 10-14, 1940.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank Brawley, 30 N. Michigan Ave., Chicago.

Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.

Place: Cleveland. Time: Oct. 6-11, 1940.

American Bronchoscopic Society

President: Dr. John D. Kernan, 103 E. 78th St., New York.

Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.

Place: New York. Time: June 5, 1940.

American Laryngological Association

President: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.

Secretary: Dr. Charles J. Imperatori, 108 E. 38th St., New York.

Place: Westchester Country Club, Rye, N. Y. Time: May 27-29, 1940.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Lee M. Hurd, 39 E. 50th St., New York.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: Waldorf-Astoria Hotel, New York. Time: June 6-8, 1940.

SECTIONS:

Eastern.—Chairman: Dr. John R. Simpson, Medical Arts Bldg., Pittsburgh.
Southern.—Chairman: Dr. Walter J. Bristow, Doctors Bldg., Columbia, S. C.
Middle.—Chairman: Dr. Sam E. Roberts, Professional Bldg., Kansas City, Mo.
Western.—Chairman: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. Horace Newhart, 527 Medical Arts Bldg., Minneapolis.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.
Place: Westchester Country Club, Rye, N. Y. Time: May 30-31, 1940.